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Workbook for

NISM-Series-IV: Interest Rate Derivatives Certification Examination

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Interest Rate Derivatives
Certification Examination

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This workbook has been developed to assist candidates in preparing for the National Institute of Securities Markets (NISM) NISM-Series-IV: Interest Rate Derivatives Certification Examination (NISM-Series-IV: IRD Examination).

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Foreword

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NISM certification examinations and training programs provide a structured learning plan and career path to students and job aspirants who wish to make a professional career in the Securities markets. Till May 2017, NISM has certified nearly 6 lakh individuals through its Certification Examinations and CPE Programs.

NISM supports candidates by providing lucid and focused workbooks that assist them in understanding the subject and preparing for NISM Examinations. The book covers basics of the interest rate derivatives, trading strategies using interest rate derivatives, clearing, settlement and risk management as well as the regulatory environment in which the interest rate derivatives markets operate in India. It will be immensely useful to all those who want to have a better understanding of various derivatives products available in Indian interest rate derivatives markets.

Sandip Ghose
Director

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While the NISM Certification examination will be largely based on material in this workbook, NISM does not guarantee that all questions in the examination will be from material covered herein.

Acknowledgement

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NISM gratefully acknowledges the contribution of the Examination Committee for NISM-Series-IV: Interest Rate Derivatives Certification Examination consisting of representatives of BSE Limited (BSE), Metropolitan Stock Exchange of India Limited (MSEI), National Stock Exchange India Limited (NSE) and Fixed Income Money Market and Derivatives Association of India (FIMMDA).

About NISM

National Institute of Securities Markets (NISM) was established by the Securities and Exchange Board of India (SEBI), in pursuance of the announcement made by the Finance Minister in his Budget Speech in February 2005.

SEBI, by establishing NISM, articulated the desire expressed by the Government of India to promote securities market education and research.

Towards accomplishing the desire of Government of India and vision of SEBI, NISM delivers financial and securities education at various levels and across various segments in India and abroad. To implement its objectives, NISM has established six distinct schools to cater to the educational needs of various constituencies such as investors, issuers, intermediaries, regulatory staff, policy makers, academia and future professionals of securities markets.

NISM is mandated to implement Certification Examinations for professionals employed in various segments of the Indian securities markets.

NISM also conducts numerous training programs and brings out various publications on securities markets with a view to enhance knowledge levels of participants in the securities industry.

About NISM Certifications

The School for Certification of Intermediaries (SCI) at NISM is engaged in developing and administering Certification Examinations and CPE Programs for professionals employed in various segments of the Indian securities markets. These Certifications and CPE Programs are being developed and administered by NISM as mandated under Securities and Exchange Board of India (Certification of Associated Persons in the Securities Markets) Regulations, 2007.

The skills, expertise and ethics of professionals in the securities markets are crucial in providing effective intermediation to investors and in increasing the investor confidence in market systems and processes. The School for Certification of Intermediaries (SCI) seeks to ensure that market intermediaries meet defined minimum common benchmark of required functional knowledge through Certification Examinations and Continuing Professional Education Programmes on Mutual Funds, Equities, Derivatives Securities Operations, Compliance, Research Analysis, Investment Advice and many more.

Certification creates quality market professionals and catalyzes greater investor participation in the markets. Certification also provides structured career paths to students and job aspirants in the securities markets.

About the Workbook

This workbook has been developed to assist candidates in preparing for the National Institute of Securities Markets (NISM) Interest Rate Derivatives Certification Examination. NISM-Series-IV: Interest Rate Derivatives Certification Examination seeks to create a common minimum knowledge benchmark for the approved users and sales personnel of the 'Trading Members' who are registered as such in the Currency Derivatives Segment of a recognized stock exchange and trading in Interest Rate Derivatives.

The book covers basics of the interest rate derivatives, trading strategies using interest rate derivatives, clearing, settlement and risk management as well as the regulatory environment in which the interest rate derivatives markets operate in India.

About the NISM-Series-IV: Interest Rate Derivatives Certification Examination

The examination seeks to create a common minimum knowledge benchmark for the approved users and sales personnel of the 'Trading Members' who are registered as such in the Currency Derivatives Segment of a recognized stock exchange and trading in Interest Rate Derivatives.

Examination Objectives

On successful completion of the examination the candidate should:

- Know the basics of fixed income securities markets and specifically interest rate derivative markets in India and developed world
- Understand the analytical framework required for Bond Futures market in India along with trading and hedging strategies involved
- Understand the clearing, settlement and risk management as well as the operational mechanism related to interest rate derivatives markets
- Know the regulatory environment in which the interest rate derivatives markets operate in India.

Assessment Structure

The NISM-Series-IV: Interest Rate Derivatives Certification Examination (NISM-Series-IV: IRD Examination) will be of 100 marks consisting of100 questions of 1 mark each, and should be completed in 2 hours. There will be negative marking of 25% of the marks assigned to each question. The passing score for the examination is 60%.

How to register and take the examination

To find out more and register for the examination please visit *www.nism.ac.in*

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Chapter 1: Fixed-income and Debt securities – Introduction

LEARNING OBJECTIVES

After studying this chapter, you should know about:

- Different kinds of asset classes in financial markets
- Different types of fixed-income or debt securities and their features
- Concept of fixed-income versus fixed return
- Concept of equity and debt capital
- Primary and secondary market for debt securities in India

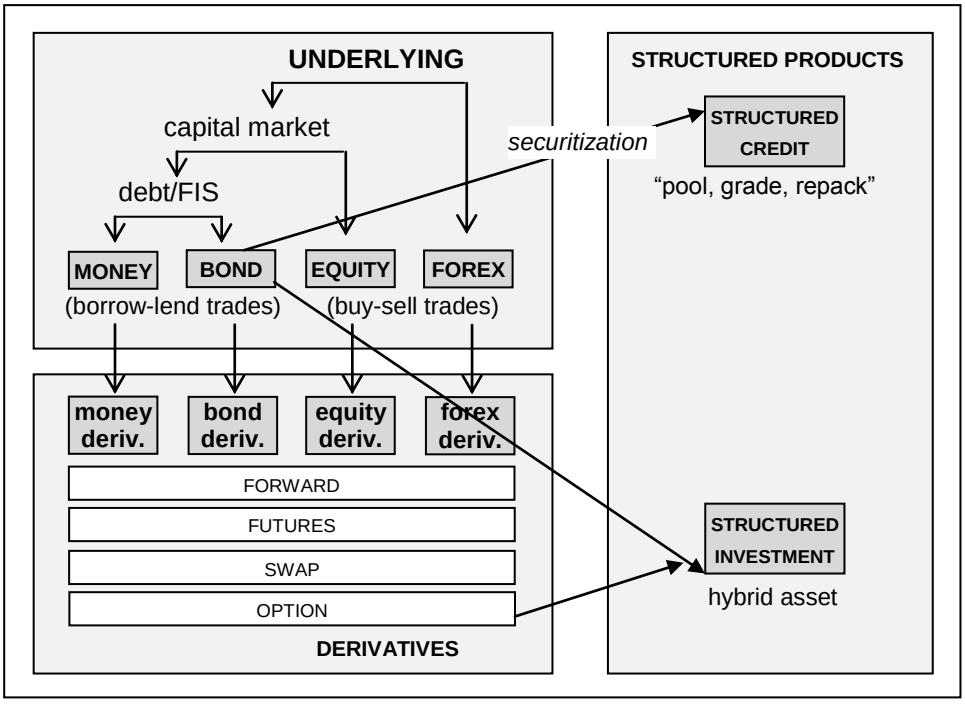
1.1 Financial Markets: Overview

Financial markets are grouped into three super asset classes: *underlying, derivative* and *structured finance*. Besides these three, there are *collective investment schemes* (e.g. mutual funds), *physical assets* (e.g. real estate, commodities, art, antiques, wine, etc) and *alternative assets* (e.g. ETFs, managed futures, hedge funds, private equity, etc). Strictly speaking, alternative assets are those whose returns are not highly correlated with those from conventional assets. By this definition, only physical assets are alternative assets and the so called "alternative assets" such as ETFs, managed futures, hedge funds, etc are not because they are alternative *strategies* with conventional assets rather than alternative asset types by themselves.

The underlying super asset class consists of fundamental assets and there are four of asset classes: *money, bond, equity* and *forex*. They are fundamental because they are independent. They are also called traditional asset classes because investors have traditionally parked their savings and investments in them. Money and bond markets together are called debt market or fixed income securities (FIS). Debt market and equity market together are called capital market because they constitute the two parts of capital of corporate bodies.

The derivative super asset class is not independent but derived (whence the name "derivative") from the underlying super asset class. The relationship between underlying and derivative is like the relationship between mother and child or between raw material and finished product. There can be no derivative without underlying. Though derivatives can be classified into the same four asset classes as their underlyings (i.e. money derivatives, bond derivatives, equity derivatives and forex derivatives), they are grouped into five asset classes: rate, credit, equity, forex and commodity. In each derivative asset classes, there are four generic products: *forward, futures, swap* and *option*. The structured finance super asset class is further grouped into two asset classes: *structured credit* and *structured investment*. Structured credit products (SCP) are derived from a pool of bonds through a process called securitization, which redistributes the cash flows from the pool to create new securities. Structured investment products (SIP) are hybrid assets and derived by combining a bond with

derivative product option whose underlying is one of the four financial underlyings or a physical asset. For example, if the option is derived from equity, the SIP will act partly like bond and partly like equity and is called equity-linked note (ELN). Similarly, there are rate-linked notes (RLN), forex-linked note (FLN), commodity-linked note (CLN), etc. The following exhibit shows the three groups of markets based on asset type.



Economic role of underlying markets is financing, which means transferring cash from those that have to those that need it. The financing is through borrow-lend of cash in money and bond markets (together called debt or fixed-income securities); and through buy-sell of business ownership in equity market. Forex market traditionally serves the function of production-consumption in international trade but can be also used for financing in the sense one can borrow or lend foreign currency instead of home currency.

Economic role of derivative markets is risk management, the risk being the risk present in the underlying from which the derivative is derived. The role of structured finance is financing combined with risk management.

1.2 Debt/Fixed-Income Securities: Introduction

Debt market, also known as fixed-income securities (FIS) market, consists of money and bond markets. The essence of FIS transaction is borrowing/lending of cash. The difference between the two markets is the period of borrowing/lending. In money market, the period is one year or less; and in bond market, it is more than one year. They are called "fixed-income" securities because of the following "fixed" features.

- Their life is *fixed*: they will be redeemed on a specified future date because all borrow-lend transactions are for a *fixed* period. The only exception to this rule is a Dutch perpetual bond issued in 1648, and five such bonds still exist. In recent years, some Indian banks and corporates have issued perpetual bonds, which are not strictly perpetuals because the issuer has call option.
- In most cases, their cash flows are *fixed*, too. In other words, the timing and size of cash flows are known in advance. In some securities (e.g. floating-rate bonds), the timing of cash flows is known in advance but not their size because the amount is linked to prevailing interest rate.

It should be noted that *fixed-income* security does not mean *fixed-return* security. It merely means that the timing of cash flows (and in certain cases, the size of cash flows, too) is fixed and known in advance. It does not necessarily guarantee a fixed *return*. For example, consider a 7-year bond that pays 9% per annum interest and issued by a company. The 9% per annum interest is not the guaranteed return for the following reasons.

1. *Credit risk:* The Company may not be able to pay interest and principal on schedule. This is called credit risk in the bond.
2. *Marker risk:* The 9% per annum will be the guaranteed return if the investor/holder holds the bond until its maturity of seven years. If the investor wants his investment back at the end of five years, he cannot demand prepayment from the issuing company but should sell it in the secondary market at the end of five years. The sale price may be higher or lower than the initial purchase price, resulting in capital gain/loss, which is not known in advance. This is called market risk (also known as price risk) in the bond.
3. *Reinvestment risk:* If your investment horizon is seven years, there should be no interim payments. If there are (such as interest payments in this example), they are to be reinvested until the horizon at unknown future interest rates. In this above example, the 9% coupon in the first year should reinvested for six years at the end of one year; the 9% coupon in the second year will have to be reinvested for five years at the end of second year; and so on. Since the reinvestment rates (and income) are not known in advance, it is called reinvestment risk.

Only in certain cases (explained later), all the three risks disappear and the fixed-income security is also a fixed-return security.

1.3 Debt/Fixed-Income Securities: Classification

FIS can be grouped into many categories, based on different parameters: cash flow pattern, tenor, issuer, credit quality, interest rate type, etc.

Types of FIS based on Cash Flow Pattern

Based on the pattern of cash flows during the life of the instrument, they are classified into *coupon bond, annuity* and *zero-coupon bond*.

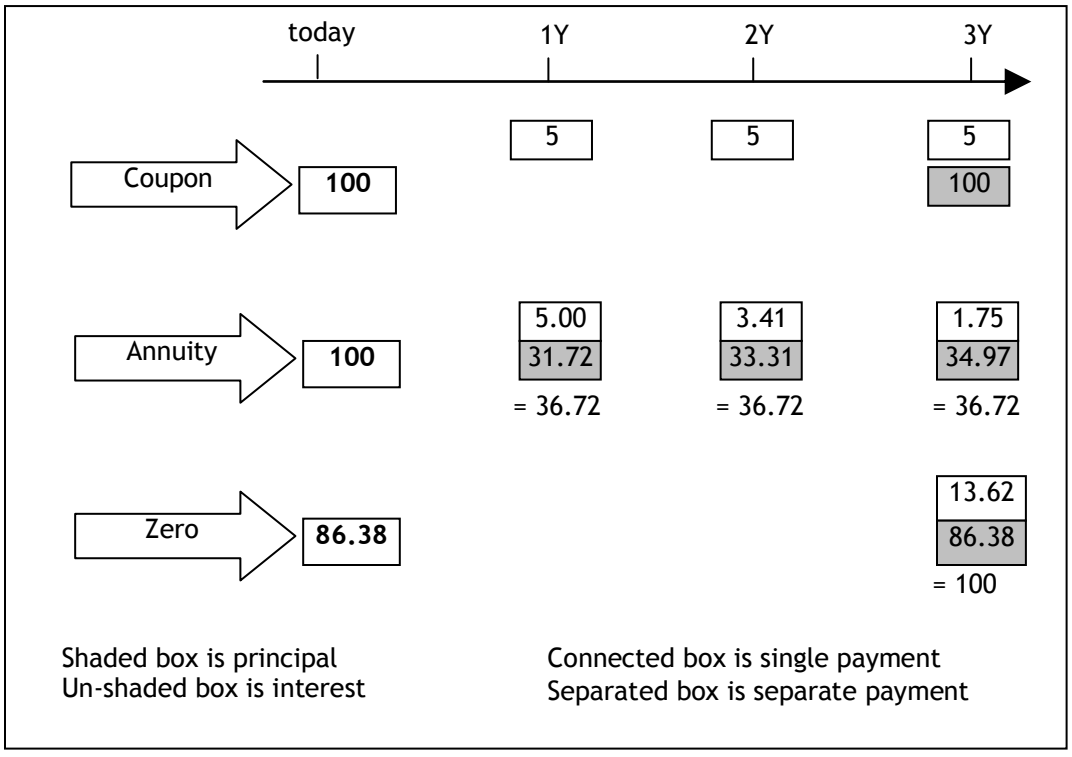
Coupon instrument pays periodic fixed amount called coupon (C), representing the interest rate; and a final fixed amount, representing the principal (P), which is also called redemption amount.

Annuity pays coupon and part of the principal periodically in such a manner that the cash flows are equal in size and equally spaced in time (e.g. equated monthly installments). Most consumer loans and housing loans are structured as annuities. As we progress towards maturity, the interest amount falls and the principal amount rises but the total amount remains the same. Since the interim payments are much higher in annuity, it has the higher reinvestment risk (see Section 1.2).

Zero-coupon bond (also called "discount" bond) does not pay any amount before maturity date. The interest is accumulated, compounded and paid along with principal at maturity as a single bullet payment. Therefore, there is no reinvestment risk (see Section 1.2).

The following exhibit depicts the cash flow pattern for three types of instruments. All of them have an implied interest rate of 5% a year, maturity of three years, redemption value of 100. The amount shown against "today" in the exhibit is the price of bond, which is an outflow for the investor.

Types of FIS by Cash Flow Pattern



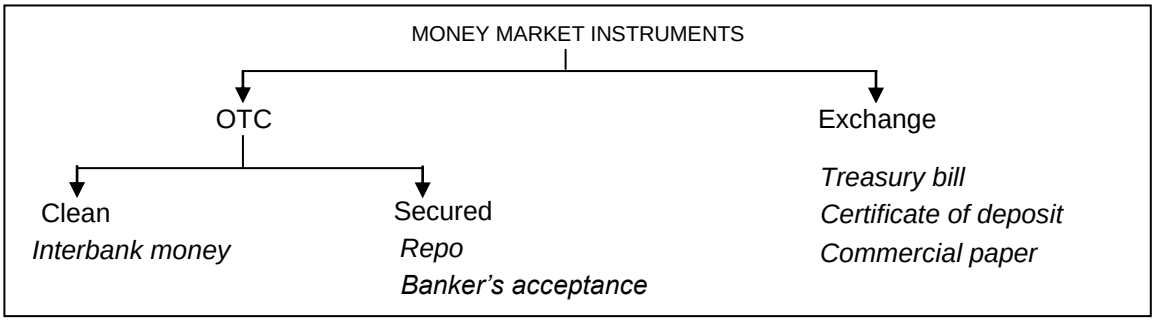
Types of FIS based on Tenor

Based on original maturity of borrowing/lending, FIS securities are classified into money and bond instruments. Money market instruments are those with an original maturity of

one year or less; and bond market instruments are those with original maturity of more than one yea.

Money market products are further grouped into two: OTC and Exchange products. The borrowing may be against collateral (called "secured") or without collateral (called "clean"). All exchange-traded money market products are clean instruments: they are unsecured promissory notes. The OTC products may be secured or unsecured; and are privately and bilaterally negotiated contracts between two parties. There is no secondary market for these instruments, and hence lender cannot get his money back before the maturity, unless the counterparty's status deteriorates to trigger loan recall.

All of them are borrow-lend trades. However, the secondary market trades before redemption in Exchange products are buy-sell between two investors.



Interbank money market

In the interbank money market, both lender and borrower are banks and the borrowing is on "clean" basis. The period of borrowing is for "standard" tenors, which are: overnight (ON), one week (1W), two weeks (2W), one month (1M) to one year (1Y) at monthly intervals. There is no tenor beyond 1Y because the money market is only up to one year. It is possible to contract for odd tenors such as 45 days, 75 days (called "stub" periods), but they are less liquid.

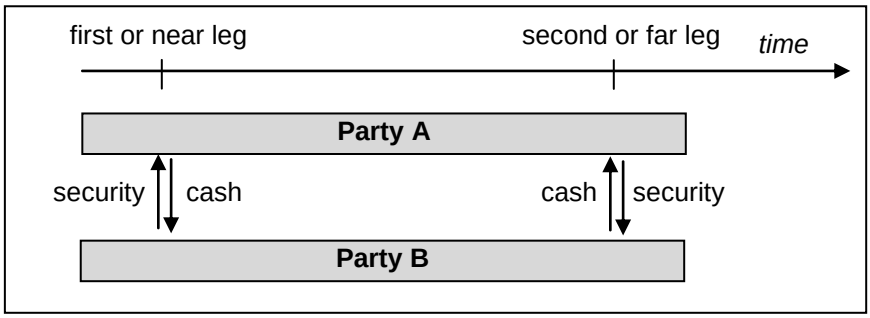
The overnight is the most important and liquid. It is called call money in India and Fed Funds in the US. The rate on overnight money indicates the liquidity status for the entire economy. If the rate remains persistently high, it is an indication that there is a shortage of money in the economy; and if the rate is persistently low, it indicates surplus money in the economy. The central banks keep close watch on the overnight rate in the interbank market for implementing monetary policy and market intervention.

Repo/Reverse Repo

Repo/Reverse repo is secured money borrowing/lending with three key features. First, being a money market product, it is money borrowing/lending for a period of one year or less. In practice, most trades are for overnight to one week. Second, it is secured lending against collateral, which is not any collateral but an actively traded, liquid and less volatile instrument. For most trades, the collateral is treasury bills or sovereign bonds, but some corporate bonds and some equity instruments are also accepted in few cases. The amount of cash lent is less than the market value of the security, and the

difference is called haircut, which corresponds to "margin" in loan markets. Third and most important, the trade is structured not as borrow-lend trade but as buy-sell trade: simultaneous sale and repurchase ("repo") of the collateral security for different settlement dates. The leg that is settled first is called first leg or "near leg" and that settled later is called second leg or "far leg." The reason for structuring it as buy-sell trade is to transfer the legal title of security to the money lender. This enables the sale of security by money lender to make good the repayment without cumbersome and costly legal process.

The cash borrower gives the security and takes cash in the first leg, which is structured as "sell" trade for cash borrower. The second leg represents the repayment of loan and structured as "repurchase" (repo) trade for cash borrower. We can turn the trade around and analyse it from the perspective of security borrowing/lending. Cash lending is security borrowing and vice versa. The following exhibit shows the flows in the trade.



The above flows can be viewed from different perspective: borrow-lend of money, borrow-lend of security, buy-sell of security on start date and end date. The exhibit below summarizes these perspectives.

Perspective	Party A	Party B
Money borrow-lend	Lender	Borrower
Security borrow-lend	Borrower	Lender
Security buy-sell on Start Date	Buyer	Seller
Security buy-sell on End Date	Seller	Buyer
Security buy-sell on both dates	Buyer-Seller	Seller-Buyer
Trade	Reverse repo	Repo

The cash borrower (i.e. security lender) has done repo and is the repo "seller"; and cash lender (i.e. security borrower) has done reverse repo and is the repo "buyer". However, the market practice is to designate the trade for both parties from the perspective of dealer (i.e. bank). If the bank has borrowed cash, it is repo for both parties; and if the dealer has lent cash, it is reverse repo for both parties. There will be confusion, however, when both parties are dealers. In this case, it is better to specify the trade for each party separately or qualify one party as repo buyer (i.e. cash lender) and the other as repo seller (cash borrower).

Based on the length of repo period, repos is classified into *open repo* (the period is one day with rollover facility and overnight rate reset) and *term repo* (the period is specified in advance and the interest rate is agreed for the whole of the term). The open repo is more liquid that term repo. Based on the collateral, repo is also classified into *general repo* and *specific repo*. In the general repo, any of the specified securities can be used as collateral with facility for substitution of the securities during the repo period. In specific repo, the collateral is restricted to a specific security with no facility of substitution.

The Exchange-traded money market instruments are treasury bills (TB), certificate of deposits (CD) and commercial paper (CP). Treasury bills (TB) are issued by the central government through RBI. They are issued with original maturity of 91-day, 182-day and 364-day and issued as zero-coupon (or discount) instruments: no stated coupon but issued at discount to the redemption price. The 91-day T Bill is auctioned every week; 182-day and 364-day T Bills are auctioned every fortnight. The 182-day T bill is not being issued now. Earlier, 14-day T bill was also issued regularly but is now discontinued. Besides this regular issuance, there is also ad hoc issuance under market stabilization scheme (MSS). The minimum and multiple amounts of issue for T bills is Rs 25,000.

CD is a negotiable, unsecured instrument issued by scheduled commercial banks (excluding regional rural banks and local area banks) and select all-India financial institutions. The minimum and multiple of issue is Rs 1 lakh. For banks, the maturity of CD should be not less than seven days and not more than one year; and for all-India financial institutions, not less than one year and not more than three years. They are issued as discount instruments or floating-rate instruments.

CP is a negotiable, unsecured instrument issued by corporate bodies and primary dealers. The minimum and multiple of issue is Rs 5 lakhs. The maturity of the CP should be a minimum of seven days and a maximum of one year. The maturity should not fall beyond the date for which the credit rating is valid. It should be issued as a discount instrument and should not be underwritten or co-accepted. However, banks can provide stand-by credit facility or backstop facility; and non-bank entities may provide unconditional and irrevocable guarantee. A scheduled commercial bank will act as Issuing and Paying Agent (IPA).

Bond market instruments are those with original maturity of one year or more. In some markets, the term “note” is used if the original maturity of the instrument at the time of issue is between one and 10 years; and the term “bond” is used if it is more than 10 years. In India, we also use the term “debenture” for bonds. Bonds can be further classified based on issuer, interest rate type, credit quality, etc.

Based on the issuer, bonds are classified into sovereign bonds and corporate bonds. Sovereign bonds are those issued by the governments and hence “risk-free” securities, (the “risk” referred to here is the credit risk - see Section 1.2). They are called by different names in different countries: Treasuries in the US, Gilts in the UK, Bunds in Germany and G-Secs in India. Sovereign bonds have a regular issue calendar. Together with Treasury Bills, they constitute the most important securities because the interest

rate on them is the benchmark for determining the interest rate on other debt securities.

Corporate bonds are those issued by corporate bodies. Unlike money market, there is no distinction for the instruments issued by banks/financial institutions and corporate bodies. All of them are called corporate bonds in bond market.

Another way to classify bonds is by the interest type, based on which we can classify them into fixed-rate, floater, and inverse floaters. If the bond's periodic coupon is known in advance, it is called fixed-rate (or coupon) bond, and most bonds are issued as fixed-rate bonds. The fixed cash flow does not necessarily mean a *constant* amount. For example, the coupon may be 5% for first year, 5.25% for second year, 4.75% in third year, and so on. The qualifying feature is that the timing and amount are known in advance, but the coupon may not be constant and may have "step-up" or "step-down" features.

If the coupon is linked to a specified market interest rate, then only its timing but not its amount is known in advance. Such bonds are said to be *floaters.* Its interest rate varies periodically and is proportional to the market interest rate: if the market rates goes up, it pays higher rate and vice versa. Inverse floater pays coupon linked to the market interest rate, but links it inversely proportional to the market rate. That is, if the market rate goes up, it pays lower amount, and vice versa. This is operationalized by setting the periodic amount as the difference between a fixed rate (FXD) minus the market rate (FLT). To avoid the negative interest amount, the difference between the FXD and FLT rates is floored at zero. Thus,

$$\text{Coupon} = \text{Max}\,(0,\ \text{FXD} - \text{FLT})$$

The following table shows the interest rate payable by floater and inverse floater, assuming that the FXD rate for inverse floater is 12%.

Market Rate	Floater	Inverse Floater Max (0, fxd – flt)
1%	1%	11%
5%	5%	7%
9%	9%	3%
14%	14%	0%

By far the most important feature of bond is its credit quality, which is specified by specialist bodies called credit rating agencies. The well-known rating agencies are Standard & Poor's (operates in India through CRISIL), Moody's (operates in India through ICRA) and Fitch. The rating agencies assign a rating based on financial position of the borrower, anticipated revenues, outlook for the industry and the competition, and the outlook for the economy. The table below shows the ratings of different agencies and their significance.

S&P	**Moody's**	**Fitch**	**Implication**
AAA	Aaa	AAA	Extremely strong

AA+	Aa1	AA+	Very Strong
AA	Aa2	AA	
AA–	Aa3	AA–	
A+	A1	A+	Strong, but susceptible to adverse changes in economic conditions
A	A2	A	
A–	A3	A–	
BBB+	Baa1	BBB+	Adequate, but is more susceptible to adverse changes in economic conditions
BBB	Baa2	BBB	
BBB–	Baa3	BBB–	
BB+	Ba1	BB+	Speculative and is susceptible to adverse changes in business, financial and economic conditions
BB	Ba2	BB	
BB–	Ba3	BB–	
	B1	B+	Speculative and is more susceptible to adverse changes in business, financial and economic conditions
B	B2	B	
	B3	B–	
CCC+		CCC+	Speculative and currently vulnerable
CCC	Caa	CCC	
CC	Ca	CC	
C	C	C	
		DDD	Default has occurred
		DD	
D		D	

The credit ratings above are not numerical measures of default. They are relative measures: AAA is stronger than AA, which in turn is stronger than A, and so on. The ratings of BBB and higher are considered as "investment grade" and those with BB and lower until C are considered "speculative grades." Further, there may be modifiers to ratings, with the modifier indicating as follows.

Modifier	Implication
+ or –	The modifier shows the relative standing within rating category
N.R.	No rating has been requested and there is insufficient information to base rating; or that the agency does not rate the instrument as a matter of policy
i	The modifier "i" indicates that it applies only to the interest rate portion of obligation; and is always used with the modifier "p". For example, "AAAp N.R. I" means that the principal portion is rated "AAA" and the interest portion is not rated.
p	The modifier "p" indicates that it applies only to the principal portion of obligation; and is always used with the modifier "i".
pi	The rating is based on publicly available information and therefore is based on less comprehensive information. Such ratings are reviewed annually based on new year's financial statements.
pr	Indicates that rating is provisional, and relies on the assumption that the project will be successfully completed.

Standard & Poor's also defines "rating outlook" and "credit watch." The rating outlook is to indicate the potential direction a long-term rating may take in the next six months to two years. The outlook is stated as:

Positive	Rating may be raised
Negative	Rating may be lowered
Stable	Rating is unlikely to change
Developing	Rating may be raised or lowered

The credit watch also relates to potential direction of both short-term and long-term rating. It focuses on identifiable events and short-term trends that cause ratings to be placed under special surveillance. It includes mergers, re-capitalization, regulatory action, voter referendums, etc. It is stated as Positive, Negative or Stable, and these have the same meaning as those under rating outlook.

Some bonds have a derivative called option embedded in it, and the embedded option modifies the redemption date or type of the bond. Three such embedded options are as follows.

Bond type	Redemption feature	Remark
Callable	Issuer has the right to prepay the bond on specified dates before maturity (i.e. issuer "calls" the bond before maturity)	Issuer will exercise his right if the interest rates fall so that he can refund at cheaper rate
Puttable	Investor has the right to demand prepayment on specified dates before maturity (i.e. investor "puts" the bond to issuer for cash)	Investor will exercise his right if the interest rates rises so that he can reinvest at higher rate
Convertible	Investor has the right to convert the bond into issuer's equity at specified price at maturity	Investor will exercise his right only when the market price of equity is higher than exercise price

1.4 Fixed-income versus Fixed-return

As stated in Section 1.2, the "fixed" in fixed-income securities is with respect to timing of cash flows, not with respect to return. However, in some cases, the fixed cash flow will be also fixed return. Let us recap the three risks in fixed-income securities.

Credit risk: It disappears when the issuer is a sovereign government because the government cannot default in its home currency. For example, government of India cannot default on rupee liabilities. However, this does not apply to borrowings in foreign currency because it cannot print foreign money.

Market risk: It disappears if the investor holds until maturity date when it will be redeemed directly by the issuer at face value.

Reinvestment risk: It disappears if the instrument is a zero-coupon instrument because there is nothing to reinvest in the interim.

Thus, if you buy a zero-coupon instrument issued by a sovereign government in its home currency and held it until maturity, there is no risk; and the fixed-income security is also a fixed-return security.

1.5 Debt versus Equity

As stated earlier, the capital of corporate bodies consists of debt and equity. If interest on debt is tax-deductible, every company's capital must have some debt. Let us examine a simplified case of two companies with same profit margin on sales but with different capital structure, as follows. Company A has a capital of Rs 50 and no debt; and company B has a capital of Rs 25 and debt of Rs 25. The debt has an interest rate of 10%. The table below shows the return on equity (ROE) for both the companies.

	Company A	Company B
A. Equity	50.00	25.00
B. Debt	0.00	25.00
C. Capital (A + B)	50.00	50.00
D. Sales	100.00	100.00
E. Profit before tax and interest (@ 10% of D)	10.00	10.00
F. Interest (@ 10% on B)	0.00	2.50
G. Profit After Interest (E – F)	10.00	7.50
H. Tax (at 30% of G)	3.00	2.25
I. Net Profit (G – H)	7.00	5.25
J. Return on Equity (I / A)	14%	21%

The ROE for Company A, which has no debt, is much less than that for Company B. The reason for this was the interest on debt is tax-deductible. It may seem that the companies should fund themselves predominantly with debt to maximize the return on equity. However, this has a negative side because interest on debt becomes a fixed-cost and will have serious repercussions in recession. Consider the scenario of recession in which the sales fall by 60% and the gross margin falls to 3% of sales. Working out the figures again in the table below show that the Company A still has a positive ROE but the Company B is in loss.

	Company A	Company B
A. Equity	50.00	25.00
B. Debt	0.00	25.00
C. Capital (A + B)	50.00	50.00
D. Sales	40.00	40.00
E. Profit before tax and interest (@ 10% of D)	1.20	1.20
F. Interest (@ 10% on B)	0.00	2.50
G. Profit After Interest (E – F)	1.20	(1.30)
H. Tax (at 30% of G)	0.36	….
I. Net Profit (G – H)	0.84	(1.30)
J. Return on Equity (I / A)	1.7%	…

We may say that equity is the cost of avoiding bankruptcy. For optimal results, there is always an optimal level of debt-to-equity ratio. The optimal ratio is such that the weighted average of cost of capital (WACC) should be minimal. The WACC is given as follows:

$$WACC = R_D\left(\frac{D}{E+D}\right)(1-T) + R_E\left(\frac{D}{E+D}\right)$$

Where,

R_D = cost of debt (which is the interest rate on debt)
D = market value of debt
E = market value of equity
T = tax rate
R_E = cost of equity.

The terms in parentheses give the proportion of debt and equity to the total capital. When they are multiplied by their respective costs (after adjusting the tax effect on debt), the result is the weighted average cost of capital (WACC). If WACC is at the lowest point, then the return to the shareholder will be the highest. Accordingly, the main goal of corporate finance is to minimize the WACC, not to minimize the cost or size of two components in capital. All terms in the equation except the cost of equity (R_E) can be readily obtained. The cost of equity must be estimated or derived from capital asset pricing model (CAPM) or similar models.

1.6 Relative Size of Debt and Equity Markets Globally

The following table shows the global size of bond (issuance and outstanding) and equity (issuance and market capitalization) markets.

(US$ billion)

Year	Bond		Equity	
	Issuance	Outstanding	Issuance	Market cap
2010	14,367	83,482		54,978
2011	13,929	86,559		48,377
2012	16,431	89,112		54,725
2013	15,802	89,178	804	59,846
2014	16,138	87,741	890	68,110
2015	17,399	87,687		67,125

Source: SIFMA Factbook 2016 and Thomson Reuters

The size of the debt market is proportional to the state of economic development. The following shows the size of debt market outstanding and market capitalization of equity market as a percentage of GDP.

(as a % of GDP)

Country/Region	Debt[1]				Equity[2]
	Government	Non-Financial Corporate	Household	Total Debt	(Market Cap as percent of GDP)
US	89	67	77	233	116
UK	92	74	86	252	116
France	104	121	56	280	68
Germany	80	54	54	188	42
Spain	132	108	73	313	73
Italy	139	77	43	259	23
Australia	31	69	113	213	84
Japan	234	101	65	400	72
China	55	125	38	217	44
India	66	45	9	120	69
Brazil	65	38	25	128	51
Russia	9	40	16	65	43

Source: McKinsey Global Institute (www.mckinsey.com/mgi) and World Development Indicators 2015 (www.worldbank.org)

1.7 Relative Size of Debt and Equity Markets in India

In the Indian debt market, the government (central and state) is the predominant borrower. During FY2014-15, the *net* borrowing by central and state government is, respectively, Rs 4,532 billion and Rs 2,075 billion. The corporate debt market is also substantial. The following shows the amount raised through equity and debt by private sector.

(in Rs billions)

Segment		2013-14	2014-15
Equity	Public offer	133	98
	Private placement	272	97
	Total	405	195

[1] For the advanced economies and China, data is pertaining to second quarter of 2014 and for other developing economies, data is pertaining to 2013.

[2] Equity Market Data is pertaining to 2012.

Debt	Public offer	424	97
	Private placement	3,720	3,761
	Total	4,144	3,858

Source: Reserve Bank of India (www.rbi.org.in)

1.8 Primary and Secondary Market for Debt Securities in India

Primary Market

The Reserve Bank of India acts as the issue manager for central and state government borrowing programs. The major factors that affect the issuances of the government debt are:

1. Liquidity conditions in the market
2. Market Preferences for maturity versus the desired maturity
3. Yields in the primary and secondary market

Apart from this, the fiscal deficit of the country also plays a major role in determining the issuances. Keeping this is mind, the RBI releases an issuance calendar for dated securities semiannually (March and September generally).This helps retail and institutional investors to plan their investments, forecast their asset requirements and imparts transparency and stability to the securities market. This calendar is modified with respect to the tenor, issue size, etc. on the basis of the timing of the Government's funding requirements.

The market issuances of government securities can be either reissuances of the existing securities or fresh issuances of new securities. The RBI determines the issue based on various parameters. The reissue of existing securities has led to consolidation of debt, evolution of the benchmark securities in the market and better liquidity conditions.

In the case of a new security, the RBI announces the tenor and the amount of the issuance. The market participants are then required to bid for the security by quoting the desired yields. In the case of reissuance of an existing security, the coupon and maturity are already known and therefore the participants bid for the security on the basis of the desired price. The auctions of these securities are done in one of the following ways:

1. Uniform Price Method: All participants are allotted at the same price. The price is the highest price (corresponding to the lowest yield) that the issuer can get their entire issue subscribed.
2. Multiple Price Method: All accepted are allotted at different prices and yields quoted in their individual bids. Successful bidders get the issue at the price and yield they bid whilst the bidder at the cut off price or yield gets the best price.

In the past, the RBI has used the uniform price auction mechanism to curb volatility in the markets. However, it sometimes uses the multiple price auction mechanism also to

get a feel of the market's perception of interest rates. RBI uses both methods depending upon prevalent liquidity in the money market, macro-economic conditions, global cues and market feedback.

Secondary Market

The Clearing Corporation of India (CCIL) was set up in 2001 to provide exclusive clearing and settlement for transactions in money, government securities and Foreign Exchange. CCIL was set up with the objective of improving efficiency in the transaction settlement process, insulate the financial system from shocks emanating from operations related issues, and to undertake other related activities that help to broaden and deepen the money, debt and forex markets in the country.

CCIL provides and maintains the Negotiated Dealing System (NDS) which is the secondary market platform to trade in government securities. CCIL has also developed and currently manages the NDS-CALL electronic trading platform for trading in call money. It has also developed the NDS-Auction module for Treasury Bills auction by RBI.

CCIL guarantees settlements of all trades, thus eliminating counterparty risk. It is the counterparty to both the buyer and the seller. It maintains a settlement guarantee fund (SGF) that is made up of margin contributions from each participant with the CCIL. CCIL also provides for Repo instruments for Government Securities –termed as Collateralized Borrowing and Lending Obligations (CBLO) and Clearcorp Repo Order Matching System (CROMS).

Once the RBI has issued the securities, they are available for secondary market trading on the Negotiated Dealing System- Order Matching (NDS-OM), which is a platform managed by the CCIL, that facilitates the buying and selling of GoI bonds.

Trading volumes in the secondary market have gone up in recent years and much of this trading is attributed to a small group government securities. This trading activity in the government securities market is captured and published by CCIL every day. Typically, the 10-year "On the run" G-Sec is the largest traded security in the secondary market. The major participants in this market are Primary Dealers, Banks (Public, Private and Foreign), Insurance Companies, Pension Funds, Mutual Funds, FPIs and retail investors. The settlement for trades done on the NDS-OM platform is on T+1 basis. However, bulk of the trading activity is intra-day.

Sample Questions

1. Which of the following instruments has no reinvestment risk?
    a. **Zero coupon bond**
    b. Annuity
    c. Coupon bond
    d. All of the above

Ans: (a)

2. Which of the following has higher credit risk?
    a. Bond rated AAA
    b. Bond rated A
    c. **Bond rated BBB**
    d. All of them have same credit risk

Ans: (c)

3. The "fixed" in fixed-income securities implies that
    a. Return is fixed
    b. Risk is fixed
    c. **Cash flows timing is fixed**
    d. All of the above

Ans: (c)

4. Which of the following makes debt an essential component of capital?
    a. Lower cost
    b. **Tax-deductibility of interest expense**
    c. Both (a) and (b) above
    d. None of the above

Ans: (b)

5. Which of the following bond pays interest in proportion to the prevailing market rate?
    a. Zero-coupon bond
    b. Fixed-rate bond
    c. **Floater**
    d. Inverse floater

Ans: (c)

Chapter 2: Interest Rate – Introduction

LEARNING OBJECTIVES:

After studying this chapter, you should know about the following:

- Risk-free rate versus risky rate
- Nominal interest rate versus real interest rate
- Term structure of interest rates
- Conversion of interest rate into interest amount
- Concept of accrued interest

2.1 Interest Rate: Concept

In buy-sell transactions, the exchange is "an asset for money", and the rate of exchange is called price; and one price applies to all market participants at a given point of time. In borrow-lend transactions, the exchange is "money for money" for different settlement dates. There is no transfer of ownership but only use of money for a period, for which rent is charged. The rent on money is called *interest rate*. Unlike the price in buy-sell trades, the rate in borrow-lend trades is not the same for all borrowers but borrower-specific. The reason for this is that borrow-lend trades have credit risk (see Section 1.2), which is faced only by lender against borrower. Therefore, the price of credit risk has to be priced and incorporated into the trade, which makes the rate borrower-specific.

2.2 Risk-Free Rate versus Risky Rate

Consider that the borrower is a sovereign government and the borrowing is in home currency. There is no possibility of default by the borrower because the sovereign can always print money and pay off the lender. In other words, there is no credit risk in this transaction. The interest rate applicable to such transactions is called "risk-free" rate, the risk here being the credit risk.

For borrowers other than the sovereign government, there is some chance of default. Therefore, the interest rate applicable to such non-sovereign borrowers must be higher than the corresponding rate for sovereign borrower. The difference between them is called the "credit spread". In practice, all borrowers are grouped according to their credit rating (which is a measure of credit risk), and the interest rate is quoted as an add-on spread over risk-free rate. For example, if the risk-free rate is 8.25% and the credit spread is 0.10% for AAA-rated borrowers and 0.25% for AA-rated borrower, the interest rate applicable to the last two are, respectively, 8.35% (i.e. risk-free rate of 8.25 + credit spread of 0.10) and 8.50% (i.e. risk-free rate of 8.25 + credit spread of 0.25).

The risk-free rate is the benchmark for *all* valuations because it represents the return without risk. All other financial instruments have various risks (such as credit risk,

market risk, etc). To bear these risks, investors would demand premium, which is an add-on amount to the benchmark return represented by risk-free rate. We may say that risk-free rate is the opportunity cost of earning return without risk.

2.3 Nominal vs. Real Interest Rate

The nominal interest rate is the stated interest rate (coupon rate) of a bond. The nominal interest rate denotes the rate that the bond issuer pays to the bond holder. However, the inflation reduces the purchasing power of money. Therefore, the nominal interest rate has to be adjusted for the rate of inflation in order to understand the real growth of money for the bond holder. The nominal interest rate adjusted for inflation is called Real Interest Rate.The relationship between real and nominal interest rates can be described in the equation:

$(1 + r) \times (1 + i) = (1 + R)$

where r is the real interest rate, i is the inflation rate and R is the nominal interest rate.

For low-level rates, this relation can be approximated as: $r = R - i$

i.e., Real interest rate = Nominal interest rate –Rate of Inflation

For example, if the nominal interest rate on a bond is 9% and the inflation rate is 6%, then the real interest rate will be around3%. Therefore, if the rate of inflation exceeds the coupon rate of a bond, the real interest rate on the bond will be negative. For example, a bond with a 7% nominal interest rate will have a real interest rate of -2% (approx), if the rate of inflation is 9%.

2.4 Term Structure of Rates: Shapes

What is the interest rate today? This question cannot be precisely answered because it is incomplete in two respects. First, the rate depends on the term (or tenor) of borrowing/lending period. Though the periods can be many, the market quotes rates only for “standard” terms/tenors, which are as follows in money and bond market.

Money market: overnight (ON), 1-week (1W), 2-week (2W), 1-month (1M) to 1-year (1Y) at the interval of a month. Of these, ON, 1M and 3M are more liquid than others.

Bond Market: 2Y, 5Y, 7Y, 10Y, 15Y, 20Y, 25Y and 30Y. Of these, 2Y and 10Y are more liquid.

Second, even for the same term, the rate differs from borrower to borrower because the credit risk is priced and incorporated into the transaction rate. As explained in Section 1.2, for the sovereign borrower, the rate is directly quoted for each term; and for non-sovereign borrowers (grouped by credit rating), what is quoted is the add-on credit spread, representing the price of credit risk. The following tables shows the hypothetical interest rates for various terms and for various borrowers rated by their credit rating (AAA, AA, A, BBB, etc.)

Term	Risk-free rate	Credit Spread		
		AAA	A	BBB
1M	5.00%	0.15%	0.25%	0.35%
3M	5.25%	0.25%	0.50%	0.75%
1Y	5.75%	0.40%	0.75%	1.10%
5Y	6.50%	0.85%	1.50%	2.25%

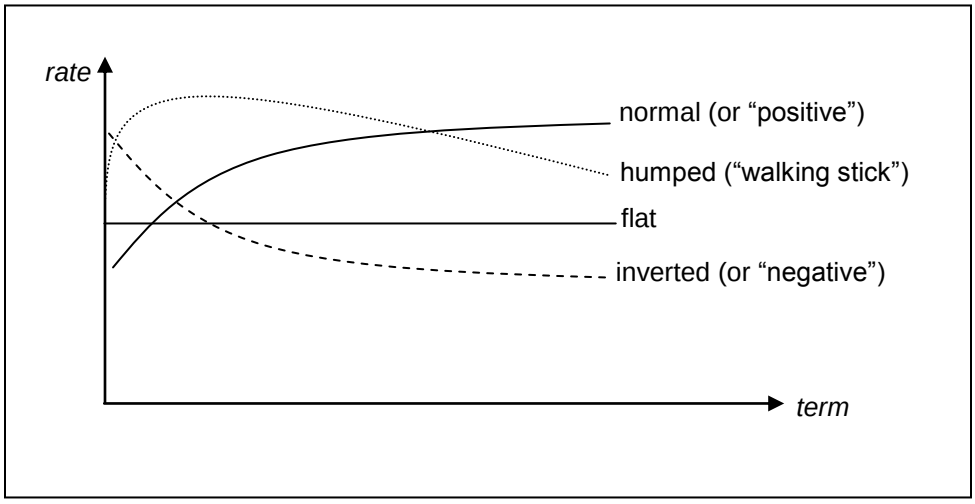
When the interest rate (on vertical axis) is plotted against the term (on horizontal axis), it is called the *term structure* of interest rates (also known as yield curve). Thus, we have "risk-free curve", "AAA curve", "BBB curve", and so on.

The term structure of risk-free rate is the most important tool in *any* valuation because it represents the ultimate opportunity cost. It is the rate an investor can earn without any risk of default or loss for a given term. Any other competing alternative has a risk, which has to be priced and added to the risk-free rate for the same term as the "risk premium." Without term structure of rates, valuation becomes speculative rather than objective.

But what determines the interest rate? The answer is demand-supply for money for different terms or periods. For example, the demand-supply for money borrowing/lending for 1Y term determines the 1Y interest rate, and so on. It is convenient to assess the demand-supply separately for short-term (i.e. 1Y or less, which is money market) and long-term (i.e. more than 1Y, which is bond market). The short-term rate is determined by liquidity, which in turn is caused by seasonal demand-supply for credit, foreign portfolio investment inflows and outflows, bunching of tax and government payments, etc. The long-term rate is predominantly determined by inflation outlook and the capital expenditure by industry and business.

In developed economies, central bank monitors and controls only the short-term interest rate, but in developing and emerging economies, central bank influences long-term rates, too. The central bank uses the repo and reverse repo with commercial banks to control the short-term rate. It uses repo (i.e. repo for commercial bank) to inject liquidity into money market and reverse repo (i.e. reverse repo for commercial bank) to drain excess liquidity. To control long-term interest rate, the central bank uses bank rate (i.e. the rate at which the central bank lends to commercial banks), cash reserve ratio, statutory liquidity ratio) and open market operations. In the Indian market, there is distortion of free play of demand-supply forces for determining the interest rate. The reason for this is that the statutory liquidity ratio (SLR) requires banks to compulsorily invest 20.5% (as of February 2017) of the time and demand deposits into sovereign debt, and the government decides what interest rate is acceptable to it. This is somewhat forced lending to the government at artificial interest rate. It also creates what is called "uncovered parity" between the interest rates in India and other countries.

The term structure has different shapes but four of the following account for most of the shapes.



Shape	Description
Normal	Longer the term, the higher is the rate
Inverted	Longer the term, the lower is the rate
Flat	Rate is the same for all terms
Humped	Rate is high for medium term and falls off on either side

Normal (or positive) term structure is the most prevalent and exists in normal market conditions. The opposite of normal curve is the inverted (or negative) curve, which may be an indicator of coming recession. In inverted curve, there is demand for short-term money (i.e. working capital) and not for long-term money (i.e. capital expenditure). Borrowers are not going for capital expenditure possibly because they expect no economic growth in the future, which explains why inverted yield curve may indicate recession in near future.

2.5 Term Structure of Rates: Shifts

Term structure is a snapshot of rates at a point of time, and there are many theories and economic arguments to explain the shapes. What is more important is, not the shape, but how it changes over time, which is called term structure "shifts". The shits describe the *relative* moves of long-term rate (LR) and short term rate (SR), and they are grouped into three: parallel, steepening and flattening, as summarized below.

Shift	Description
Steepening	Difference between LR and SR rises or widens (from positive to more positive or from negative to less negative). The curve shifts in anti-clockwise direction.
Flattening	Difference between LR and SR falls or narrows (from positive to less positive or from negative to more negative). The curve shifts in clockwise direction.
Parallel	All rates move in the same direction by same extent

Steepening and flattening can occur in three ways: both rates move in opposite direction; both rates move in the same direction (either both rise or both fall) but by different extent; and one rate remains and the other changes (either rise or fall). The first is called “twist” and the last two are called “convexity change”.

The following example illustrates the shifts:

Before				After				Shift
SR	LR	Spread	Shape	SR	LR	Spread	Shape	
7.00%	8.00%	+1.00%	Normal	6.90%	8.10%	+1.20%	Normal	Steepening – twist
7.00%	8.00%	+1.00%	Normal	7.10%	8.20%	+1.10%	Normal	Steepening – Convex change
7.00%	8.00%	+1.00%	Normal	6.80%	7.90%	+1.10%	Normal	Steepening – Convex change
7.00%	8.00%	+1.00%	Normal	6.90%	8.00%	+1.10%	Normal	Steepening – Convex change
7.00%	8.00%	+1.00%	Normal	7.00%	8.10%	+1.10%	Normal	Steepening – Convex change
7.00%	8.00%	+1.00%	Normal	7.10%	8.10%	+1.00%	Normal	Parallel
7.00%	8.00%	+1.00%	Normal	6.90%	7.90%	+1.00%	Normal	Parallel
8.00%	7.00%	–1.00%	Inverted	7.90%	7.10%	–0.80%	Inverted	Steepening – twist
8.00%	7.00%	–1.00%	Inverted	8.10%	7.20%	–0.90%	Inverted	Steepening – Convex change
8.00%	7.00%	–1.00%	Inverted	7.80%	6.90%	–0.90%	Inverted	Steepening – Convex change
8.00%	7.00%	–1.00%	Inverted	7.90%	7.00%	–0.90%	Inverted	Steepening – Convex change
8.00%	7.00%	–1.00%	Inverted	8.00%	7.10%	–0.90%	Inverted	Steepening – Convex change
8.00%	7.00%	–1.00%	Inverted	8.10%	7.10%	–1.00%	Inverted	Parallel
8.00%	7.00%	–1.00%	Inverted	7.90%	6.90%	–1.00%	Inverted	Parallel
7.00%	8.00%	+1.00%	Normal	7.10%	7.90%	+0.80%	Normal	Flattening – twist
7.00%	8.00%	+1.00%	Normal	7.20%	8.10%	+0.90%	Normal	Flattening – Convex change
7.00%	8.00%	+1.00%	Normal	6.90%	7.80%	+0.90%	Normal	Flattening – Convex change
7.00%	8.00%	+1.00%	Normal	7.10%	8.00%	+0.90%	Normal	Flattening – Convex change
7.00%	8.00%	+1.00%	Normal	7.00%	7.90%	+0.90%	Normal	Flattening – Convex change
8.00%	7.00%	–1.00%	Inverted	8.10%	6.90%	–1.20%	Inverted	Flattening – twist
8.00%	7.00%	–1.00%	Inverted	8.20%	7.10%	–1.10%	Inverted	Flattening – Convex change
8.00%	7.00%	–1.00%	Inverted	7.90%	6.80%	–1.10%	Inverted	Flattening – Convex change
8.00%	7.00%	–1.00%	Inverted	8.10%	7.00%	–1.10%	Inverted	Flattening – Convex change
8.00%	7.00%	–1.00%	Inverted	8.00%	6.90%	–1.10%	Inverted	Flattening – Convex change
8.00%	8.00%	0	Flat	8.10%	8.10%	0	Flat	Parallel

8.00%	8.00%	0	Flat	7.90%	7.90%	0	Flat	Parallel
8.00%	8.00%	0	Flat	8.00%	8.10%	+0.10%	Normal	Steepening – Convex change
8.00%	8.00%	0	Flat	8.10%	8.20%	+0.10%	Normal	Steepening – Convex change
8.00%	8.00%	0	Flat	7.90%	8.10%	+0.20%	Normal	Steepening – twist
8.00%	8.00%	0	Flat	8.00%	7.90%	–0.10%	Inverted	Steepening – Convex change
8.00%	8.00%	0	Flat	7.90%	7.80%	–0.10%	Inverted	Steepening – Convex change
8.00%	8.00%	0	Flat	8.10%	7.90%	–0.20%	Inverted	Flattening – twist

2.6 Conversion of Rate into Amount

The market practice is to always quote interest rate as percentage per annum, but in the settlement of transaction, the interest *rate* is converted into interest *amount*. The conversion requires the following parameters to be specified: payment frequency, compounding frequency, day count fraction and payment timing.

Payment frequency

It specifies whether the payment is monthly, quarterly, semiannual, annual or at the end of the term. For money market instruments, the market convention is to pay interest at the end of the term. That is, for 3M instrument, interest is paid at the end of 3M; for 6M instrument, at the end of 6M; and so on (M indicates month here). For bond market instruments, the market convention is to pay interest half yearly.

Compounding frequency

It specifies whether the interest is compounded or simple. If compounding is applicable, the compounding frequency must be higher than and an integral multiple of payment frequency. For example, if the payment is quarterly, the compounding frequency must be monthly or weekly or daily, but cannot be semiannual or annual. For most settlements, compounding is not applied because it is settled periodically (e.g. monthly or semiannual) over the life of the instrument. Compounding is applied only when the interest is paid after more than a year and as a bullet payment.

Day count fraction (or *day count basis*)

It specifies how to convert the payment period into year fraction (e.g. 6M = 0.5Y). For this conversion, we must agree on counting the number of days in a year and in the interest accrual period. It is expressed as a fraction. The numerator indicates the method of counting the number of days in the payment period; and the denominator indicates the total number of days in a year or 'full coupon period'. There are different conventions, but only three are used in India: actual/360, actual/365 and 30E/360.

It is the convention in all markets to include the first day of the period and exclude the last day of the period for interest accrual. For example, in the period from 30-April-2006 to 05-May-2006, there is one day in April and four days in May.

Actual/360

Count the actual number of days in the given period and divide it by the constant of 360 regardless of leap or non-leap year. For example, the day count fraction for the payment period of 30-April-2006 to 05-May-2006 is: 5/360.

Actual/365

Count the actual number of days in the given period and divide it by the constant of 365 regardless of leap or non-leap year. For example, the day count fraction for the payment period of 30-April-2006 to 05-May-2006 is: 5/365.

30E/360 (also known as "30/360" or "Eurobond basis")

The method assumes that every month has uniformly 30 days so that full year has 360 days. If the day of either start date or end date is 31, it is arbitrarily set to 30. After the day of start date and end date are shortened when required, the period as year fraction is computed as:

$$[360 \times (Y2 - Y1) + 30 \times (M2 - M1) + (D2 - D1)] / 360$$

where Y, M and D are the year, month and day, respectively; and 1 and 2 refer to the start date and end date, respectively. For example, the accrual period is from 31-Dec-2004 to 25-Jan-2005. The day of the start date, being 31, needs to be shortened to 30, while the day of the end date requires no adjustment. After the adjustment, the Y2, Y1, M2, M1, D2 and D1 are 2005, 2004, 1, 12, 25 and 30, respectively.

$$[360 \times (2005 - 2004) + 30 \times (1 - 12) + (25 - 30)] / 360 = 25/360.$$

Payment timing

It specifies whether the interest amount is paid upfront (in which case it is called discount yield") or in arrears (in which case it is called "investment yield") of the payment period.

FIMMDA rules in India

Fixed-income and Money Market Derivatives Association (FIMMDA) is the self-regulatory organization in India for money, bond and derivatives markets. According to FIMMDA rules, the following are the market conventions.

Round-off of Interest Amounts

All interest amounts must be rounded off to the nearest whole rupee.

Round-off of Price and Yield

Price (per face value of 100) and yield (in percentage format) quotes must be rounded to the nearest fourth decimal place when used in interest amount calculations. The exception is the second leg of repo/reverse repo transaction for which price can be quoted up to the nearest eighth decimal point.

Day Count Basis

Day count basis for all transactions is Actual/365 Fixed except for the accrued interest calculation in the secondary market for sovereign bonds, for which is it is 30E/360.

Yield Quote on Money Market Discount Instrument

Yield on money market discount instruments (T Bill, CD, CP) must be quoted on true yield (Y) basis and not on discount yield basis; and for bill rediscounting, it should be in discount yield (DY) basis.

The following example illustrates the interest amount for the following loan/bond: face value is 100,000; payment period is March 31 to June 30; interest rate is 10%. (Note payment frequency is quarterly)

Case A: Simple interest, day count fraction is Actual/365, payment timing is in arrears. Day count for accrual is 91 (consisting of 1 for March, 30 for April, 31 for May and 29 for June)

$$1{,}000 \times 10\% \times 91/365 = 2{,}493.15 \approx 2{,}493 \text{ (paid on June 30)}$$

Case B: Simple interest, day count fraction is 30E/360, payment timing is in arrears. Day count for accrual is 90, consisting of 1 for March (which is March 30, not 31), 30 for April, 30 for May (and not 31) and 29 for June.

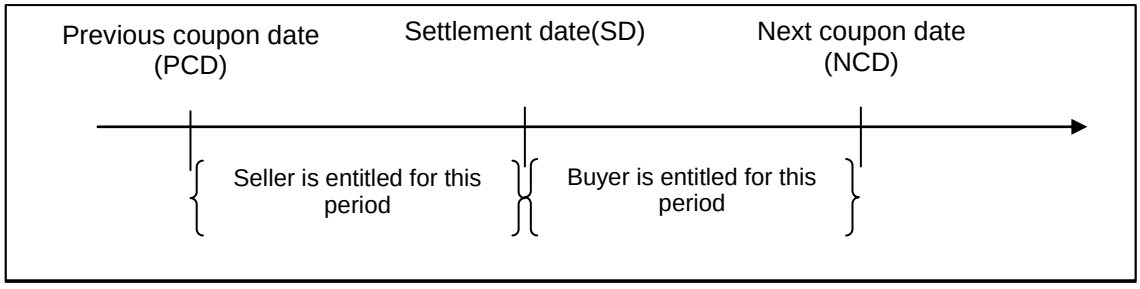
$$1{,}000 \times 10\% \times 90/360 = 2{,}500 \text{ (paid on June 30)}$$

Case C: Simple interest, day count fraction is Actual/360, payment timing is in advance.

$1{,}000 \times 10\% \times 91/360 = 2{,}527.78 \approx 2{,}528$ (paid on March 31 and is called discount yield)

2.7 Accrued Interest

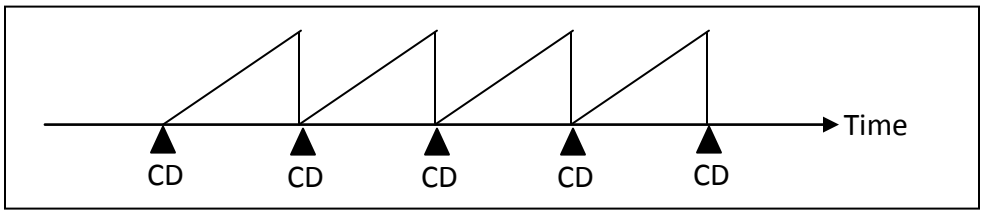
Accrued interest is a market practice peculiar to bond market. Accrued interest applies only when a bond is a coupon bond (or any other instrument for which coupon for the current interest period is known). For the secondary market trades of such bonds, there are two prices. They are "clean price": the price at which the bond is negotiated; and "dirty price" (also known as "invoice price"): the price at which the bond is settled. Dirty price is always higher than the clean price by the amount of accrued interest rate. In other words, dirty price is clean price plus accrued interest. Accrued interest is the interest accrual at coupon rate from the previous coupon date to the settlement date of the trade. Let us see the timeline of different dates in the following figure:


Previous coupon date (PCD)
Settlement date(SD)
Next coupon date (NCD)
Seller is entitled for this period
Buyer is entitled for this period

The settlement date of the secondary market trade falls between two coupon date, which we will designate as previous coupon date and next coupon date. Between previous coupon date and settlement date, it is the seller that owns the bond and therefore is entitled to receive the interest accrual for this period. Similarly, it is buyer that owns the bond between settlement date and next coupon date and therefore he is entitled to the interest accrual only for this period. However, the issuer does not keep

track of who owns the bonds for which period during the coupon period. Whosoever owns the bond on next coupon date, he gets the coupon for the full period. Accordingly, the buyer gets the coupon for the full period, which means that the seller is deprived of his entitlement. To make the trade fair to both parties, buyers computes the interest accrual from previous coupon date to settlement date, and pays to the seller as an add-on amount of "accrued interest" at the time of settlement, and gets it reimbursed on the next coupon date.

A logical question is why not include accrued interest in the market price or clean price of the bond so that the negotiated price (or clean price) recorded in the deal ticket is the same as the settlement price (or dirty price)? If we incorporate the accrued interest in the market price of bond itself, the result will be a periodic rise-and-fall pattern in bond price between two coupon dates. Because the daily interest accrual is constant, the price will rise smoothly every day by daily accrual amount from one coupon date (CD) to the next, and falls abruptly by the full coupon amount on the next coupon date.



This is how the bond price will change between two coupon dates if accrued interest is incorporated in market price. And this pattern of change will repeat in all other coupon periods. This saw-tooth like price change is in addition to two other sources of price change, which are price change due to change in interest rate; and price change due to change in credit rating of the issuer. The former affects all bonds, and the latter will affect only the bonds of a particular issuer. Of the three sources of change in bond price, that due to accrued interest is known in advance, but that due to interest rate and credit rating changes are not known in advance. The known changes are called 'deterministic' and the unknown changes are called 'stochastic'. Traders would like to monitor only the stochastic changes. There is no use of monitoring deterministic changes, which are already known. Therefore, accrued interest is removed from the market price, and is made an add-on amount in the settlement.

Accrued interest is peculiar to bond market. Its equivalent in equity market, which is 'accrued dividend' does not exist. One may argue that dividend is contingent and not known in advance. However, after the company announces the dividend payout, the amount is known. Therefore, for all trades in secondary market between announcement date and ex-dividend date, the concept of 'accrued dividend' can be implemented. Dividend's contribution to the total return from equity is negligible. Therefore, the concept of 'accrued dividend' is ignored. Coupon's contribution to total return from bond may be 50 – 100%. Therefore, the concept of 'accrued interest' cannot be ignored.

Sample Questions

1. Credit spread is the price of
    a. **Credit risk**
    b. Reinvestment risk
    c. Price risk
    d. All of the above

Ans: (a)

2. If the long-term rate is 10% and short-term rate is 8%, the shape of term structure of rates is
    a. **Normal/positive**
    b. Inverted/negative
    c. Flat
    d. None of the above

Ans: (a)

3. If both the long-term rate and short term rate is 10%, the shape of term structure of rates is
    a. Normal/positive
    b. Inverted/negative
    c. **Flat**
    d. None of the above

Ans: (c)

4. If the spread between long-term rate and short-term rate has changed from +0.75% to +1.25%, the shift in term structure is
    a. **Steepening**
    b. Flattening
    c. Parallel
    d. None of the above

Ans: (a)

5. The concept of accrued interest applies to which of the following
    a. Zero coupon bond
    b. **Coupon bond**
    c. Both (a) and (b)
    d. None of the above

Ans: (b)

Chapter 3: Return and Risk Measures for Debt Securities

LEARNING OBJECTIVES:

After studying this chapter, you should know about:

- Return measure: spot rate
- Concept of coupon, current yield, yield-to-maturity, spot rate, bond price and yield-to-maturity
- Measures of price risk of fixed income securities - duration, rupee duration, PVBP and convexity

3.1 Return Measure: Spot Rate

Return on investment is the most important measure of performance. It has the following properties.

- Expressed as a rate per annum
- If there is income before the investment term, the income has to be reinvested until the term
- Compounding at less than yearly intervals, if required, is incorporated

If there is no interim income, then it is simple to compute the return as follows.

$$\left\{\left[\frac{F}{P}\right]^{\frac{1}{N\times C}} - 1\right\} \times C$$

where

F = final amount received (i.e. face value)
P = initial amount invested (market price)
N = number years
C = compounding frequency

The first term, (F/P), is the growth factor: it indicates how much the unit amount has grown into over the entire investment term. For example, if Rs 100 grows into Rs 150 over three years, the growth factor is 1.5: one unit has grown into 1.5. The exponent term, the reciprocal of (N × C), converts the growth factor from "per investment period" to "per compounding period". The third term, deducting unity from the "per compounding period" growth factor, converts it from growth factor to growth rate. The fourth term, *C*, converts the "per compounding period" growth rate into annualized compounded growth rate, which is how the return is expressed. Using the same example of Rs 100 resulting into Rs 150 after three years, the return measure with different compounding frequency is:

With annual compounding: $\left\{\left[\frac{150}{100}\right]^{\frac{1}{3\times 1}} - 1\right\} \times 1$ = 14.4714%.

With semiannual compounding: $\left\{\left[\frac{150}{100}\right]^{\frac{1}{3\times 2}} - 1\right\} \times 2$ = 13.9826%.

With quarterly compounding: $\left\{\left[\frac{150}{100}\right]^{\frac{1}{3\times 4}} - 1\right\} \times 4$ = 13.7464%.

With monthly compounding: $\left\{\left[\frac{150}{100}\right]^{\frac{1}{3\times 12}} - 1\right\} \times 12$ = 13.5919%.

The above is the true and realized return. In the above example, we can say that we have earned 13.5919% per annum for every month for the next three years, and the interest earned every month is automatically reinvested at the same rate of 13.5919% per annum until the end of three years. This return, which is the realized return, is also called *zero rate* or *spot rate*. A 5Y zero rate of 7.5% means that the return on initial investment is 7.5% for first year, which is reinvested automatically for four more years at the same rate of 7.5%; the return for the second year is 7.5%, which is reinvested automatically for three more years at the same rate of 7.5%; and so on.

For zero-coupon securities (i.e. discount instruments), it is possible to readily compute the true return or zero rate because there are no interim cash flows. The redemption value corresponds to the *F* and the initial purchase price corresponds to the *P*. For coupon bonds and annuities, it is not possible to compute true return because of interim cash flows, which need reinvestment until maturity. The reinvestment rates are not known until the reinvestment time (except when the future cash flows are locked through interest rate derivatives), and therefore true return is not known at the beginning ("ex ante") but known only at the end of investment period ("ex post"). At the end of investment period, all the reinvestment rates are known, and we can compute the true return, which is called *holding period return* (HPR). Since HPR can be computed only ex post and not ex ante, some other approximate measures of return are developed for coupon bonds and annuities. They are *coupon*, *current yield* and *yield-to-maturity*.

3.2 Coupon, Current Yield and Yield-To-Maturity

The commonly used interest rates in FIS market are coupon, current yield and yield-to-maturity (YTM), none of them is a true return measure but only approximation.

Coupon

Coupon cannot be considered the return because it does not consider the premium/discount in bond price and the capital gain/loss at redemption. For example, a 3Y 8% coupon bond purchased at a price of 103. We cannot consider coupon of 8% as the return, because the bond pays the following amounts during its life.

Year	Amount	Return
1	8	8 / 103 = 7.7670%
2	8	8 / 103 = 7.7670%
3	8 + 100	(108 /103) – 1 = 4.8544%

In the third year, there is redemption and therefore we must convert the growth factor into growth rate. We find that the return is 7.7670% per annum for the first two years and 4.8544% for the third year. We cannot consider these as true return because the first year coupon must be reinvested for two more years; and the second year coupon must be reinvested for one more year. Unless these reinvestment rates are known, we cannot compute the true return even for a single year except for the last. And then we need to blend all three true returns into a single return measure. Thus, coupon is not a return measure because it ignores: (1) the premium/discount in bond price; (2) capital gain or loss at redemption; and (3) reinvestment rate of periodic cash flows.

Current yield

Current yield is defined as coupon divided by bond price. For the bond in the earlier example, the current yield is:

$$8 / 103 = 7.7670\%$$

Current yield is better than coupon but is still unsatisfactory. It considers the premium/discount in bond price but ignores the capital gain/loss and reinvestment rate; and therefore cannot be a true return.

Yield-to-maturity

Yield-to-maturity (YTM) is the most widely used measure is simply called "yield". However, it is still not a true return measure. YTM considers the premium/discount in bond price and capital gain/loss at redemption and even handles the reinvestment in a rough way. What it does is: (a) amortizes the capital gain/loss at redemption over the bond's life and adds it to the current yield; (b) averages the returns for all periods in a complex way; and (c) assumes that interim cash flows are reinvested at the same average return. A crude method to compute YTM using the same example is as follows. The capital loss is Rs 3, which, when amortized over three years is: 3 /3 = 1. The loss of 1% is added to the current yield of 7.7670, resulting in the YTM of 6.7670%. And it assumes that the periodic coupons are reinvested at the same 6.7670%. The more precise way of computing YTM is explained in Section 3.4.

YTM in bond market is also called *internal rate of return* (IRR) in corporate finance and *effective yield* (EY) in accounting/tax jargon.

3.3 Spot Rate, Bond Price and YTM

Spot rate (also known as "zero rate") is the true return on investment, as explained in Section 3.1. It considers premium/discount in bond price, capital gain/loss at redemption and reinvestment of interim income. It is computed according to the formula give at the beginning of this chapter. It is also called "zero rate" because it can be readily computed from the market price of zero-coupon bond, using the formula in the beginning.

Since the zero rate (Z) is the true return, the present-value of any future cash flow will be its discounted value, the discounting being at the zero rate relevant to the timing of the cash flow. Bond (or any financial instrument) is a set of cash flows occurring at

different times during its life. The current market price of bond should be its cash flows discounted at the appropriate zero rates from the prevailing term structure of zero rates. Consider the earlier 3Y 8% coupon bond. The current market price of the bond should be

$$\text{Price} = \frac{8}{(1+Z_1)^1} + \frac{8}{(1+Z_2)^2} + \frac{108}{(1+Z_3)^3}$$

where Z_i is the zero rate for the *i*th year. For the above example, what is the true return? The answer is that there is no single answer but there are three answers. For the first year, the return is Z_1 on a final amount of 8; for the second year, Z_2 on a final amount of 8; and for the third year, Z_3 on a final amount of 108. Assuming that the term structure of zero rates is 7.75%, 8.00% and 8.25%, respectively, for the first, second and third years, the market price of the bond will be as follows.

Year	Zero rate (Z)	Cash flow	Discounted value
1	7.75%	8	$8 / (1.075^1) = 7.4246$
2	8.00%	8	$8 / (1.08^2) = 6.8587$
3	8.25%	108	$108 / (1.0825^3) = 85.1413$
		Total	**99.4246**

The above brings in two important facts. First, the bond price is determined, not by demand-supply for bond, but by term structure of zero rates. It should be noted that the demand-supply forces do have a play, but that is demand-supply for money, not for bond. The demand-supply for money determines the zero rates, which in turn determine the bond price. Second, in a coupon bond (or annuity), there is no single return measure but multiple of them. In the above example, the return is 7.75% for one year for a final amount of 8; 8% for two years for a final amount of 8; and 8.25% for three years for a final amount of 108. The interpretation of 2Y zero rate of 8% means this: you earn 8% for one year, which will be automatically reinvested at the same 8% for one more year. Similarly, the 3Y zero rate of 8.25% implies that in the first year, the return is 8.25%, which is reinvested at the same rate for two more years; and in the second year, the return is the same 8.25%, which is reinvested for one more year at the same rate. If there is a 10Y coupon bond with semiannual payment, there will be 20 different return measures, each corresponding to the cash flows. To make it easier for interpretation, we average all the rates into a single number, which is called YTM. For the earlier 3Y 8% coupon bond, the YTM is derived from the bond price as follows:

$$99.4246 = \frac{8}{(1+YTM)^1} + \frac{8}{(1+YTM)^2} + \frac{108}{(1+YTM)^3}$$

It can be solved through trial-and-error method by starting at a guess rate and progressively increasing or decreasing it. For the above example, YTM has to be 8.2241% for the above equation to be satisfied.

The above shows that YTM is not a return measure but another way of quoting bond price (because it is derived from bond price). Alternately, given YTM, the bond price can be derived from the above equation. Both bond price and its variant of YTM cannot be used as judgment tools to determine the mispricing, as shown by the following example. There are two bonds issued by the same issuer and with the same maturity of 3Y. One bond has a coupon of 8% and the other 9%. The market prices of these bonds, given the following term structure of zero rates, and the translation of price into YTM will be as follows:

Year	Zero Rate	Bond A		Bond B	
		Coupon	Disc Amount	Coupon	Disc Amount
1	7.7500%	8	7.4246	9	8.3527
2	8.0000%	8	6.8587	9	7.7160
3	8.2500%	108	85.1413	109	85.9296
Total			99.4246		101.9983
YTM			8.2941%		8.2215%

Both bonds have the same maturity and issued by the same issuer. Therefore, maturity-related price risk and issuer-related credit risk are the same for both bonds. Which bond is better? Bond A would seem under-priced at 99.4246 and Bond B would seem overpriced at 101.9983. However, this is incorrect because we are comparing apples with oranges. Both bonds are priced correctly at the same term structure of zero rates. The price cannot be used as a judgment tool for determining the mis-pricing. Since YTM is another way of quoting price, it cannot be used as judgment tool, too. Only if the actual market price of the bonds is different from 99.4246 (for Bond A) and 101.9983 (for Bond B), we can say that there is a mispricing or cheapness/richness of bonds.

Investor may still have preference for the bonds, which is decided by factors other than price or YTM. These factors are tax considerations and expectations about future interest rates for reinvestment. If you expect interest rate would rise in future, then you may prefer Bond B because higher amount of Rs 9 will be reinvested at higher rate. Similarly, if capital gains are taxed at lower rate than income, then investor will prefer Bond A because it has lower income of Rs 8 a year and a capital gain at redemption.

To sum up, the following are the drawbacks in using YTM as a true return measure.

- By using the same rate for all cash flows, it assumes that the term structure of zero rates is flat, which is inconsistent with reality.
- Bond with different coupons but with same maturity will have different YTMs (which is called “coupon effect”). In other words, YTM is inconsistent because it simultaneously assumes different levels of term structure of zero rates at the same time. In the above example, YTM assumes that term structure of zero rates is flat at 8.2941% for Bond A and 8.2215% for Bond B, whereas the actual rates are 7.75%, 8% and 8.25% for 1Y, 2Y and 3Y, respectively.

- YTM is inconsistent in another way: it assumes different reinvestment rates simultaneously. In the above example, it assumes the reinvestment rate to be 8.2941% for Bond A and 8.2215% for Bond B, while the actual investment rates are unknown.

To sum up, using bond price or YTM to compare bonds for their fair value is like comparing apples and oranges. The only way to judge the fair value of bonds is to compare their sum of discounted cash flows at zero rates. All we can infer about the bond price and YTM is as follows:

- If the price is below par value (i.e., discount), YTM will be higher than coupon
- If the price is above par value (i.e., premium), YTM will be lower than coupon
- If the price is at par, YTM will be the same as coupon

For zero-coupon bond, YTM is the true measure of return because there are no interim cash flows to be reinvested and there is a single zero rate used.

3.4 Risk Measures

As stated in Section 1.2, there are three risks in FIS, which are

- Credit risk: The possibility of default by issuer and therefore the source of risk is the issuer.
- Price risk (also known as market risk): The possibility of change in bond price before maturity because of change in market interest rate and therefore is also called interest rate risk.
- Reinvestment risk: The uncertainty of reinvestment rate for cash flows received before maturity (e.g. coupons).

If the issuer is a sovereign government, there will be no credit risk because government will not default in its own currency. If the bond is held until maturity, there will be no price risk because of "pull-to-par" effect of bond price at maturity. If the bond is a zero-coupon bond, there will be no reinvestment risk because there are no interim cash flows to be reinvested until maturity. Since most bonds are issued by non-sovereign issuers and are coupon bonds, all the three risks are present in the bond. We will consider only price risk and reinvestment risk and ignore the credit risk.

Price risk and reinvestment risk always work in the opposite way. For example, if the market rate rises, the bond price falls but reinvestment income rises. The bond price falls because of discounting at a higher interest rate results in lower present value; and reinvestment income rises because the interim cash flows are reinvested at higher than the original interest rate. Similarly, if the market interest rate falls, the bond price rises but reinvestment income falls. The change in bond price is instant after the change in interest rate but the effect of reinvestment income is slow over a period of time.

Macaulay Duration

Macaulay was the first to measure the price risk. He proposed that bond maturity is a rough measure of price risk. Consider a change of 1% rise in the interest rate. The price

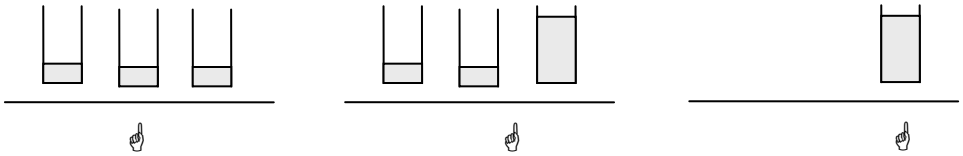
of 1Y zero-coupon bond will fall by roughly 1%; that of 2Y zero-coupon bond will fall by roughly 2%; that of 3Y zero-coupon bond will fall by roughly 3%; and so on. Thus, the change in the bond price is roughly proportional to the maturity. The periodic coupon will make the effective maturity less than the legal maturity because of coupon payments before the legal maturity. The reduction in effective maturity will correspondingly bring down the riskiness of the bond. The measure of risk is the weighted average of years in bond's life, the weights being the cash-flows discounted at YTM. Macaulay explained this with an intuitive example such as the one below. Consider a 10% 2Y coupon bond currently priced at 101.7125, corresponding to YTM of 11%. Let us derive the discounted cash flows and the time-weighted discounted cash flows.

Time	YTM	Discount Factor	Cash Flow	Discount Cash Flow (DCF)	Time-Weighted DCF (TDCF)
(a)	(b)	$1 / (1+b)^a$	(c)	(b) × (c)	(a) × (b) × (c)
1	11%	0.900901	12	10.8108	10.8108
2	11%	0.811622	112	90.9017	181.8034
				101.7125	192.6142

The sum of (DCF) is the current price of the bond, of course. If we divide the sum of TDCF with the sum of DCF, what we get is T or time, which Macaulay called it as "Duration" (D), which he considered the effective maturity of bond and a measure of price risk. For the above example, Macaulay's Duration (D) is:

$$192.6142 / 101.7125 = 1.89$$

Notice that the units for Duration are the time units (in this example, years). Thus the effective maturity is brought down from 2Y to 1.89Y. For zero-coupon bonds, since there are no interim cash flows, D will be exactly the same as bond's maturity. An intuitive interpretation of duration is that it points to the centre of gravity. Imagine a plate on which are placed a series of glasses filled with water. The glass corresponds to the year of cash-flow; and the amount of water in it, to the amount of cash-flow. The pointer, which corresponds to Duration, indicates the place where you hold the plate to maintain balance.



The first is annuity (equally-sized and equally-spaced cash flows) whose D is half-way in its legal maturity. The second is a coupon bond whose D will be slightly less than its maturity. The third is a zero-coupon bond whose D is the same as its maturity.

Modified Duration

Subsequently, a better measure for price risk is derived by computing the sensitivity of bond price to changes in YTM. This measure is called Modified Duration (MD) and is related to Macaulay Duration (D) as follows.

$$MD = \frac{D}{\left(1 + YTM/n\right)}$$

where *n* is the frequency of compounding in a year. For the above example, MD will be, assuming annual compounding,

$$1.89 / (1.11) = 1.71.$$

MD gives the *percentage* change in bond price caused by a small change in YTM. For example, if MD is 1.71 and YTM changes by a small amount, then the bond price changes by 1.71 times the change in YTM. Designating the changes as Δ,

$$\frac{\Delta P}{P} = \mathrm{MD} \times \Delta YTM$$

where *P* is the bond price. We can solve the above equation for absolute change in bond price, ΔP, which is also called *sensitivity*, as follows.

$$\Delta P = P \times \mathrm{MD} \times \Delta YTM$$

Applying these measures to the earlier example bond (whose price is 101.7125) and assuming that YTM changes by 1% from 11% to 10%, the MD will indicate the following changes in bond price.

$$101.7125 \times 1.71 \times 1\% = 1.74$$

MD is additive, meaning that the MD for a portfolio of bonds is simply the algebraic sum of the weighted average of each bond's MD, the weights being the amount of bonds. For example, a portfolio consists of the following two bonds.

Bond	Price	Qty	Value	MD	Weighted MD
$Bond_1$	81.1622	100	8,116.22	1.82	14,771.52
$Bond_2$	101.7125	200	20,342.50	1.72	34,989.10
		TOTAL	28,458.72		49,760.62

Portfolio MD = 49,760.62 / 28,458.72 = 1.75.

Thus, if the YTM changes by 0.1%, the portfolio's value would change by 0.175%. MD is a better measure of price risk than D but is not a perfect measure for three reasons. First, it holds good only for small changes (say, changes in YTM of 0.01% to 0.10%). Second, the relationship between bond price and YTM is not linear but convex while MD assumes a linear relationship. To capture the effect of convexity, we require a second derivative of price to yield, which is called *convexity*. Third, by using YTM rather than the

term structure of zero rates, MD assumes flat term structure at the level of YTM and assumes parallel shifts in term structure. If the shift is steepening or flattening, MD does not hold good even for small changes in rates.

MD is affected by YTM, coupon, and maturity. It is inversely proportional to coupon and YTM: higher the coupon or higher the YTM, the lower is the MD. It is proportional to maturity: the longer the maturity, the higher the MD, but it flattens (or even decreases) as maturity extends beyond 30 years. The following table summarizes the effect of these factors on MD.

Factor	**Level**	**Effect on MD**
Maturity	Higher	Higher
Yield	Higher	Lower
Coupon	Higher	Lower
Coupon frequency	Higher	Lower

Price value of basis point (PVBP) and rupee duration (RD)

Senior management and risk managers are interested in change in the *total* market value of the bond portfolio for a given change in the YTM. For that, they need to replace bond price with the market value of the bond portfolio in the equation, as follows.

Change in portfolio market value = Portfolio market value × Portfolio MD × Change in YTM

This is called rupee duration (RD). For example, if the portfolio's current market value of Rs 987.89 Cr and the portfolio MD is 5.68, then change in market portfolio for a change of 0.10% in YTM will be:

$$987.89 \times 5.68 \times 0.10\% = \text{Rs } 5.61 \text{ Cr.}$$

Unlike in equity and forex markets, daily changes in YTM are very small and are about 0.01% to 0.10%. The change in YTM of 0.01% (or 0.0001) is called a *basis point* (BP) or "bip". Bond traders would like to know what would be the change in bond price for a change in YTM of one BP, which is called price value of basis point (PVBP or PV01). Since one BP is 0.0001 in YTM, PVBP can be derived from MD as follows.

$$\text{PVBP} = \text{P} \times \text{MD} \times 0.0001$$

For example, if the current price of bond (P) is 101.7125 and its MD is 1.71, then PVBP will be

$$101.7125 \times 1.71 \times 0.0001 = 0.0174.$$

Sample Questions

1. Which of the following is a true measure of the realized return for a coupon bond?
    a. Current yield
    b. Yield-to-maturity (YTM)
    c. Coupon
    d. None of the above

Ans: (d)

2. Which of the following is a correct measure of the realized return for a zero-coupon bond?
    a. Current yield
    b. Yield-to-maturity (YTM)
    c. Coupon
    d. None of the above

Ans: (b)

3. Bond A and Bond B are issued by the same issuer and have the same maturity. Bond is priced at 99 and Bond B at 101. Which of the two bonds is a better investment?
    a. Bond A
    b. Bond B
    c. The one with the higher coupon
    d. Bonds cannot be judged based on their prices

Ans: (d)

4. Yield-to-maturity (YTM) assumes which of the following?
    a. Term structure is flat
    b. Shift in the term structure is parallel
    c. Reinvestment rate is the same as YTM
    d. All of the above

Ans: (d)

5. If yield-to-maturity rises, then
    a. Bond price falls
    b. Reinvestment income rises
    c. Both (a) and (b)
    d. None of the above

Ans: (a)

Chapter 4: Interest Rate Derivatives

LEARNING OBJECTIVES:

After studying this chapter, you should know about:

- Definition and economic role of derivatives
- Functioning of Interest rate derivatives
- OTC versus Exchange-traded derivatives
- Derivatives Market in India

4.1 Derivatives: Definition and Economic Role

Derivative is something that is *derived* from another called the underlying. The underlying is independent and the derivative is dependent on and derived from the underlying. The derivative cannot exist without the underlying. This is the general definition of derivative.

However, accounting standards like FAS 133 (in the US), IAS 39 (in the EU) and AS 30 (in India) impose more qualifications for derivatives. For example, IAS 39 and AS 30 require the following three criteria to be satisfied for financial derivatives.

1. Value of derivative is linked to the value of underlying
2. Trade settled on a "future" date
3. On trade date, there should be no full cash outlay

FAS 133 requires an additional qualification:

4. Trade must settle (or capable of being settled) on *net* basis and not on gross basis.

The first requirement implies that the price of derivatives is determined by the price of underlying, and not by the demand-supply for derivative. The underlying is the raw material and derivative is the finished product. If the underlying price goes up (or down), the derivative price will go up (or down) regardless of demand-supply for derivative.

The "future" date in the second requirement means that the settlement of the derivative must be later than that for underlying. For example, if the underlying settles on two business days after trade date (T+2), the derivative on that underlying must settle later than T+2; if the underlying settles in T+5, the derivative on that underlying must settle later than T+5; and so on.

The third requirement provides "leverage": ability to buy the underlying without fully paying for it immediately or sell it without delivering it immediately.

Derivatives are classified into five asset classes: rate, credit, equity, forex and commodity. In each asset class, there are four generic products: *forward, futures, swap* and *option*.

Forward and Futures are functionally similar and involve buying or selling of a specified underlying asset at specified price for specified quantity for delivery on a specified *later* date. The difference between them is that the forward is an OTC market instrument (i.e. privately negotiated bilateral contract) and the futures is publicly-traded Exchange contract. Accordingly, they differ in the institutional arrangement for conducting the Trade and Settlement parts of the transaction.

Swap is different in the sense it does not involve exchange of cash for an underlying asset: it involves exchange of *returns* from the underlying against *return* from money. In other words, the cash-for-asset exchange is replaced with return-for-return exchange. The return from money is interest rate and that from the underlying asset is another interest rate (if the underlying is money or bond) or dividend and capital gains/loss (if the underlying is equity) or foreign currency interest rate and capital gain/loss (if the underlying is currency). Swap is traded only in OTC market.

Option does not buy or sell the underlying or its returns: it involves buying or selling certain *right* on the underlying. It is traded both in OTC and Exchange markets. The following table summarizes the key feature of four generic types of derivatives.

Generic derivative	**Key feature**	**Market**
Forward	To buy or sell the underlying with cash for settlement on a future date	OTC
Futures	To buy or sell the underlying with cash for settlement on a future date	Exchange
Swap	To buy or sell returns from the underlying with returns from cash over a period	OTC
Option	To buy or sell a right on underlying with cash for settlement on a future date	OTC and Exchange

The four asset classes and four generic types give us sixteen types of derivatives as follows, of which "bond swap" does not exist.

Under lying	**Derivatives**			
	Forward	**Futures**	**Swap**	**Option**
Money	FRA[1]	Interest rate futures	Interest rate swap[2]	Interest rate option
Bond	Bond forward	Bond futures		Bond option
Equity	Equity forward	Equity futures	Equity swap	Equity option
Forex	FX forward	FX futures	Currency swap[3]	FX option

[1]Forward rate agreement (FRA)

[2]The underlying for swap is money (and not bond) and the tenor of swap is between one year and 25 years. Thus, the swap is typically a long-tenor (or bond market) instrument. Though there is an instrument

called “bond swap”, it is not a derivative but a cash market instrument; and involves exchange of one bond for another, which is more like a barter trade.

[3]Currency swap is different from similar-sounding “forex swap”. The former is a derivative and the later is a cash market product and the forex counterpart of repo/reverse repo in FIS market.

Economic Role of Derivatives

The economic role of underlying markets is financing and consumption. In contrast, the economic role of derivatives is risk management, and the risk they manage is price risk (also known as market risk).

Price risk is the uncertainty about future return (or future price changes). The future return may be positive (called profit) or negative (called loss). Thus, risk is a neutral concept: it does not necessarily mean loss (it only signifies the uncertainty). Risk merely says that in future there will be either profit or loss.

Derivatives are tools to manage price risk. How you manage risk depends on your attitude to risk, and there are two attitudes: love and hate. When you love risk, you take risk, which is called speculation, but that word is avoided and instead we use “trading” in banking industry and “investment” in asset management industry. When you hate risk, you manage it one of the three ways: elimination (called hedging); insurance and minimization (called diversification). The following table summarizes the approaches to market risk management.

Approach	**Explanation**
Speculation	Taking risk (more formally called “trading” or “investment”) It results in the possibility of positive return (i.e. profit) or negative return (i.e. loss) in future
Hedging	You are already exposed to risk and hedging eliminates that risk and locks in the future return at a known level
Insurance	You are already exposed to risk and insurance selectively eliminates the negative return but retains the positive return. It has an explicit upfront cost, unlike speculation and hedging, which do not have any cost. It requires a particular derivative called option to implement it.
Diversification	It reduces both return and risk but in such a way that risk is reduced more than return so that risk is minimized per unit return (or, alternately, return is maximized per unit risk). It does not require derivatives to implement it.

Different underlying assets have different price risk. The prices of money and bond instruments change due to changes in market interest rate and in the credit quality of the issuer. The first is called the interest rate risk (and is the price risk in these instruments) and the second is the credit risk, whose source is the issuer, not the market. Equity and forex instruments change in their prices because of changes in demand-supply for them and are called equity risk and currency risk, respectively. Different derivatives deal with different price risks. For example, interest rate

derivatives deal with interest rate risk; currency derivatives with currency risk; and so on.

4.2 Interest Rate Derivatives

Interest rate derivatives are the most important among all derivatives, as shown in the following tables of notional outstanding amount:

Notional Amount Outstanding (USD Billion) in Exchange Traded Derivatives as of June 2015

Exchange Traded Products	**Futures**	**Options**
Interest rate	26,116	35,707
Currency	233	155
Equity index	1,698	6,314
Total - All markets	**27,047**	**42,176**

Source: Bank for International Settlement

Notional Amount Outstanding (USD Billion) in OTC Derivative Products as of June 2017

Foreign exchange contracts	76,980
Interest rate contracts	415,914
Equity-linked contracts	6,836
Commodity contracts	1,401
Credit derivatives (Credit default swaps)	9,868
Other derivatives	107
Unallocated	31,330
Total	**542,435**

Source: Bank for International Settlement

We can see that the outstanding notional of OTC derivatives is 8 times that of Exchange-traded derivatives; and together they are more than 10 times the total world's GDP.

The interest rate derivatives market is the largest derivatives market in the world. As per one estimate of the Bank of International Settlements, the global OTC derivatives market in December 2014 was US$ 630 trillion out of which around US$ 500 trillion was contributed by the Interest rate derivatives market.

We can see that interest rate derivative outnumber their counterparts in other underlying markets. The reason is quite obvious: every business or corporation faces interest rate risk (and therefore need to use interest rate derivatives) while they need not necessarily face other risks like equity risk, currency risk, etc. In contrast, equity risk is faced only by investment companies with exposure to equity market; currency risk is faced only by those with exports and imports; and commodity risk is faced only by those with exposures to commodities. It should be noted that interest rate derivatives are different from bond derivatives, as summarized in the following table:

Feature	Interest rate derivative	Bond derivative
Underlying	Interest rate on money; and the tenor can be short term (less than 1Y) or long term (more than 1Y and up to 30Y)	A specific instrument issued by a specific borrower
Liquidity	Very high	Very low
Settlement	Compulsory cash settlement (i.e. no borrowing/lending takes place because they are not financing tools)	May be physical or cash

The following table summarizes the four generic types of derivatives among interest rate and bond derivatives. In the table below, the terms used have the following meaning.

Tenor: period of notional borrowing/lending in the contract

Term: The distance of commencement date (of notional borrowing/lending period) from trade date.

Short: Less than one year

Long: More than one year

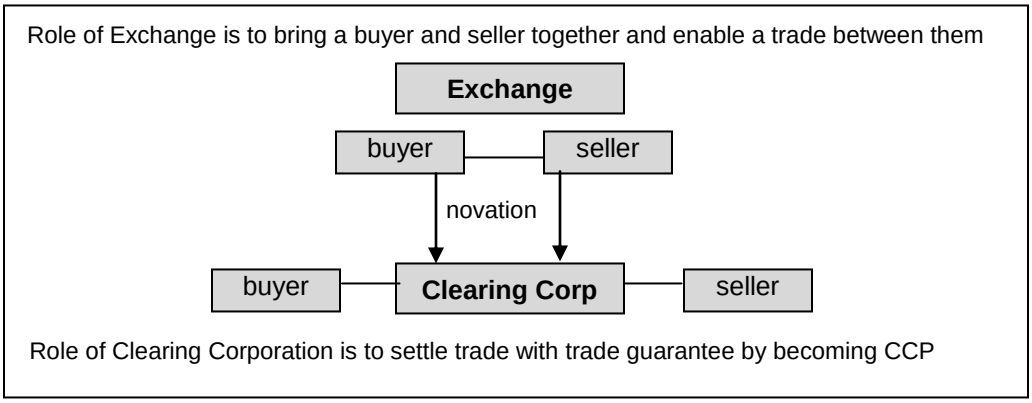
Thus, short-tenor and short-term rate means that the borrowing/lending will be for period of less than one year ("short tenor") and thatit commences within one year ("short term").

Derivative	Interest rate	Bond
Forward	Forward rate agreement (FRA). It is a contract to pay or receive a short-tenor short-term rate	Bond forward It is a contract to buy or sell a short-tenor or long-tenor instrument, usually in short-term
Futures	Interest rate futures (IRF) It is a contract to pay or receive a short-tenor rate for short-term or long-term	Bond futures It is a contract to buy or sell a short-tenor or long-tenor instrument, usually in short-term
Swap	Interest rate swap It is a contract to exchange a fixed long-tenor rate for a variable ("floating") short-tenor in the long term	Does not exist
Option	Interest rate option It is a contract to pay or receive a short-tenor rate in the short term or long term	Bond option It is a contract to buy or sell a short-tenor or long-tenor instrument, in short-term or long-term

4.3 OTC versus Exchange-traded Derivatives

Based on the style in which a transaction is negotiated and settled, the market can be classified into two segments: over-the-counter (OTC) and Exchange.

OTC derivatives (OTCD) are privately negotiated and settled contracts between two parties whereas Exchange-traded derivatives (ETD) are publicly negotiated and settled contracts with the aid of Exchange (which conducts the trade negotiation and execution) and Clearing Corporation (which conducts the settlement). There are other differences, too. OTCDs can be customized to the specific requirements of the parties where are ETDs are "standardized" in the sense that the trade amount (called "market lot" or "Contract Amount") and the settlement date (called "expiry date") are pre-determined by the Exchange. Another difference is that OTCDs have counterparty credit risk (which is the risk of failure of the counterparty before settlement date) and settlement risk (which is the risk of default by the counterparty on settlement date), but both risks do not arise in ETDs because of "trade guarantee" by Clearing Corporation. The trade guarantee is provided by Clearing Corporation becoming a common party, called central counterparty (CCP), to the buyer and seller through the process of novation, as shown below. We say that both buyer and seller novated the original trade to Clearing Corporation so that Clearing Corporation becomes the buyer to the seller; and the seller to the buyer.


Role of Exchange is to bring a buyer and seller together and enable a trade between them
Exchange
buyer
seller
novation
buyer
Clearing Corp
seller
Role of Clearing Corporation is to settle trade with trade guarantee by becoming CCP

Clearing Corporation protects itself from the counterparty credit risk and settlement risk from both buyer and seller by implementing two processes called margining and mark-to-mark, which are discussed in Unit 6.

Due to increased competition between OTC and Exchange markets, the differences between them are slowly fading. For example, today many derivatives Exchanges abroad offers customized contracts through the facilities of request-for-quote (RFQ) and Exchange-for-Physical (EFP); and OTC market offers both standardized (called "vanilla" products) and customized (called "exotic" products). There are electronic communication networks called "e-trading" platforms in OTC market that does the functions of an Exchange for price discovery and trade execution. Many OTC markets are going through central counterparty (CCP) clearing for multilateral settlements, like in Exchange markets. In India, Clearing Corporation of India Ltd (CCIL) is offering CCP

services for settlement with trade guarantee for many OTC derivative products in India. The margining and mark-to-market processes of Exchange markets have proved so useful that OTC market implements them today where it is called "collateral management".

4.4 Derivatives Market in India

Though OTC derivatives have had a long history in India, particularly in forex market, Exchange-traded derivatives are introduced only in the last decade. The following table shows the important milestones in the development of Exchange-traded financial derivatives in India:

Year	Derivative
June 2000	Index futures
June 2001	Index options
July 2001	Single stock options
November 2001	Single stock futures
June 2003	Bond futures on 10Y bond (abandoned later)
August 2008	Currency futures
August 2009	Bond futures on 10Y bond (re-launch) - Cheapest to deliver from a basket
March 2011	Treasury Bill futures
December 2011	Additional bond futures on 2Y and 5Y bonds
December 2013	10 year IRF on notional GoI Securities. Cash settlement for 10Y interest rate futures permitted
June 2015	Exchange traded cash settled IRFs on 6Y and 13Y GoI securities permitted

Derivatives are essential for risk management, especially hedging. Though, theoretically, underlying securities can be used for hedging, such a process is cumbersome, costly and non-optimal. In the Indian market, the OTC forex market has had a long-history of using the forward contract for hedging currency risk by exporters and importers; and, in recent years, currency swaps and currency options have been introduced to provide for diverse and flexible hedging strategies. Exchanges have started in 2008 the currency futures to compete with the OTC market, and they were received very well. In the equity market (which is predominantly an Exchange market), derivatives were introduced a decade ago and have overtaken the cash market in daily turnover shortly after they were introduced.

For banks, financial institutions and businesses, the exposure to rupee interest rate risk is much more severe than that to currency risk and equity risk. Accordingly, one would expect that the interest rate derivatives market would be larger than that for currency

and equity derivatives. However, interest rate derivatives were the last to be introduced in India and took off only in the third attempt in 2014. Though the OTC interest rate derivatives market has been successful with good volumes for interest rate swaps (Overnight Index Swaps), Exchange-traded interest rate derivatives had not been so successful.

The first attempt in June 2003 launched three futures contracts on 91-day Treasury Bill, 6% 10Y bond and zero-coupon 10Y bond of Government of India. The launch was a failure and the contracts were withdrawn soon thereafter. The second attempt was made in August 2009 with launch of bond futures on a notional 7% 10Y GOI bond. As the settlement for the futures was on the basis of a "cheapest-to-deliver" methodology, this was also not adopted by the market. In March 2011, another futures on 91-day Treasury bill was introduced, followed by two more futures on 2Y bond and 5Y bond.

The product design of interest rate derivatives launched prior to December 2013 suffered from the following drawbacks which led to their failure:

Cheapest to Deliver: The seller of the futures contract can deliver any one of the designated Deliverable Bonds in the basket. In theory, the introduction of Conversion Factor for each Deliverable Bond should make the seller indifferent to any preference for particular bond. In practice, however, there is a particular bond (called the "cheapest-to-deliver" or CTD bond) that every futures seller will prefer to deliver. The reason for this preference is that the Conversion Factor does not change during the Delivery Month while the prices/yields of Deliverable Bonds do change during trading hours. Accordingly, the futures price will be tracking the cash market price of the CTD bond. In the Indian scenario, sellers chose to offload their cheapest i.e. the most illiquid bonds in favor of the liquid ones as a result of which buyers were not keen on taking positions in the interest rate futures market. Moreover, trading preference in the Indian market is skewed towards the on–the–run security which contributes almost 70-80 per cent of traded volume. The other bonds in the basket were sparsely traded and at prices which were at high discounts relative to the on-the-run bond.

Physical Settlement: The other reason for its failure was earlier IRF products required physical settlement and not cash settlement. Physical settlement is when people have to give the bond at settlement where-as in cash settlement, one adjusts the differences against cash.

Zero Coupon Yield Curve (ZCYC Curve): When IRF was first launched in 2003, it was based on the ZCYC curve whilst the Indian market was more in tune with Yield to Maturity. Additionally, zero coupon bonds are generally not available across the entire spectrum of time and hence statistical estimation processes are used which the Indian market was not very proficient in. The market participants were not familiar with the computation methodology for ZCYC and the Term Structure of Interest Rates.

Based on revised guidelines from SEBI and RBI in December 2013, the Exchanges have introduced "Cash settled interest rate futures (IRF) on 10-year Government of India Securities. This product is a cash settled single bond futures, based on the on–the–run

10-year GOI bond, and has been a success. Further to this, in June 2015, SEBI and RBI have permitted to launch Interest rate futures on 6-year and 13-year GOI securities.

Over all, Exchange-traded derivatives have been more successful in equity and currency than in interest rate markets, as the following table shows. However, the Interest Rate Futures market is growing at a slow yet steady pace.

Growth of Turnover in various segments of Indian securities markets (in Rs Crores)

Year	Equity Spot Market	Equity Derivatives	Currency Derivatives	Interest Rate Derivatives
2011-12	34,78,391	3,21,58,208	98,96,,413	Negligible
2012-13	32,57,087	3,87,04,572	87,10,504	Negligible
2013-14	33,41,337	4,75,75,571	69,80,855	39,944
2014-15	51,84,500	7,59,69,290	56,34,563	4,73,783
2015-16	49,77,278	6,93,00,843	75,90,387	6,63,359
2016-17	60,54,422	9,43,77,241	83,26,651	4,38,341

Source: SEBI

Sample Questions

1. Which of the following is the role of derivatives?
    a. Financing
    b. Cash or liquidity management
    c. Risk management
    d. All of the above

Ans: (c)

2. Which of the following derivatives have the largest market size globally?
    a. Equity derivatives
    b. Interest rate derivatives
    c. Currency derivatives
    d. Commodity derivatives

Ans: (b)

3. Which of the following derivatives have the largest market size in India?
    a. Equity derivatives
    b. Interest rate derivatives
    c. Currency derivatives
    d. Commodity derivatives

Ans: (a)

4. Bond futures usually are settled as follows _____.
    a. Cash settlement
    b. Physical settlement
    c. Both (a) and (b)
    d. None of the above

Ans: (c)

5. Which of the following correctly describes “hedging”?
    a. Risk reduction
    b. Risk minimization
    c. Risk insurance
    d. Risk elimination

Ans: (d)

Chapter 5: Contract Specification for Interest Rate Derivatives

LEARNING OBJECTIVES:

After studying this chapter, you should know about following:

- Underlyings on which interest rate derivatives are traded in India
- Market lot for IRD contracts
- Contract Month, Expiry/Last Trading Day and Settlement Day for IRDs
- Price Quotation, tick size and trading hours for IRDs
- Daily and Final Settlement Price
- Delivery under physical settlement

The "interest rate derivatives" traded on Exchanges in India are not truly interest rate derivatives but bond derivatives (see Section 4.2). The underlying for interest rate derivatives is the interest rate on money, typically, the interbank money; and the underlying for bond derivatives is a specific debt security issued by a specific borrower. Globally, interest rate derivatives dominate bond derivatives because the interest rate market is large while the market for debt securities is fragmented into specific instruments, which are not fungible with each other. However, the name "interest rate derivatives" has become stuck in India to what actually are bond derivatives.

5.1 Underlying

Reserve Bank of India (RBI), whose permission is required for all derivatives on interest rate and debt instruments (whether traded in Exchange or OTC market), has permitted futures on the following underlying securities and on the following terms:

Underlying	**Features of futures contract**
91-day Treasury Bill	Settlement method: cash Security: actual (i.e. real, traded security) Final settlement price (FSP): weighted average price/yield obtained in the weekly auction on the Expiry Date of futures
2-year and 5-year central government bond	Settlement method: cash Security: notional (i.e. imaginary, non-traded) with a coupon of 7% per annum (with semi-annual compounding) FSP: Yield on a basket of securities specified by Exchanges for each futures contract based on SEBI guidelines. Yields shall be polled in accordance with the RBI guidelines.
10-year central government bond	Settlement method: cash Security: actual or notional 1) Actual security: The security shall have a remaining maturity between 8 years and 11 years from the Expiry Date of futures. The actual

	underlying security shall be determined by Exchanges in consultation with Fixed Income and Money Market Derivatives Association (FIMMDA). FSP: Weighted average price of the underlying security during the last two hours of trading in the Negotiated Dealing System – Order Matching (NDS-OM) platform of RBI. If less than five trades occur during the last two hours of trading, then FIMMDA price shall be used for final settlement. 2) Notional security: The underlying shall be a weighted basket of Government of India securities, with residual maturity between 8 years and 11 years from the Expiry Date of futures. Exchange shall determine the criteria for securities and their weights in the basket. FSP: First, obtain the weighted average yield for each security from the trades during the last two hours of trading in NDS-OM. If less than five trades occur during the last two hours of trading, then FIMMDA price shall be used. Next, take a weighted average yield for all securities in the basket. This is the yield for FSP.

RBI has delegated powers to further define the futures contract terms (e.g. contract amount, expiry months, etc, defined below) to SEBI.

According to SEBI guidelines, interest rate derivatives are to be traded in the Currency Derivatives segment of Exchange. Members of Currency Derivatives segment are allowed to participate in the interest rate futures market.

Feature	91-day Bill futures	10-year single Bond futures
Underlying security	91-day GOI Treasury Bill	GOI security with 8-11 years of residual maturity Currently (in March 2018), 6.97% bond due on 6th Sep 2026, 6.79% bond due on 15th May 2027 and 7.17% bond due on 8th Jan 2028
Settlement	Cash settlement	Cash settlement

Further to this, in June 2015, SEBI in consultation with RBI has issued guidelines to allow cash settled interest rate futures contracts to be launched on 6 years and 13 years Government of India Securities. The 6 year GoI security (with a residual maturity of 4 to 8 years) and the 13 year GoI security (with a residual maturity of 11 to 15 years) together with 10 year GoI security (with a residual maturity of 8 to 11 years) provides continuity. This allows for a continuous bucket wherein a security that was in the 10 year bucket, once off-the-run can move into the 6 year tenor interest rate futures bucket. Similarly, a security that was in the 13 year bucket, once off-the-run can move into the 10 year bucket. This will also ensure that a yield curve can be discovered through the Interest Rate Futures Market.

The contract terms of 6 year and 13 year contracts read as follows:

Underlying	**Features of futures contract**
6-Year cash	**Security (Actual or Notional):**

settled Interest Rate Futures contracts	Option A- Actual security: The underlying shall be a coupon bearing Government of India security of face value Rs. 100 and residual maturity between 4 and 8 years on the expiry of futures contract. The underlying security shall be decided by stock exchanges in consultation with the Fixed Income Money Market and Derivatives Association (FIMMDA). Currently (in March 2018), the following GoI securities fall in this category: 6.84% bond due on 19th Dec 2022, 7.68% bond due on 15th Dec 2023 and 7.72% bond due on 25th May 2025. Option B - Notional Security: The underlying shall be coupon bearing notional 6-year Government of India security with a face value of Rs. 100. For each contract, there shall be basket of Government of India securities, with residual maturity between 4 and 8 years on the day of expiry of futures contract, with appropriate weight assigned to each security in the basket. The underlying security shall have coupon with semi-annual compounding. Exchanges shall disclose criteria for including securities in the basket and determining their weights such as trading volumes in cash market, minimum outstanding etc. **Trading Cycle:**Three serial monthly contracts and Three serial quarterly contracts of the cycle March / June / September / December **Settlement:** Option A: The contract shall be cash-settled in Indian rupees. The final settlement price shall be arrived at by calculating the volume weighted average price of the underlying security based on prices during the last two hours of the trading on Negotiated Dealing System-Order Matching (NDS-OM) system. If less than 5 trades are executed in the underlying security during the last two hours of trading, then FIMMDA price shall be used for final settlement. Option B: (a) The contract shall be cash-settled in Indian rupees. The final settlement price shall be based on average settlement

	yield which shall be volume weighted average of the yields of securities in the underlying basket. For each security in the basket, yield shall be calculated by determining weighted average yield of the security based on last two hours of the trading in NDS-OM system. If less than 5 trades are executed in the security during the last two hours of trading, then FIMMDA price shall be used for determining the yields of individual securities in the basket.
13-Year cash settled Interest Rate Futures contracts	**Security - Actual or Notional:** Option A - Actual security The underlying shall be a coupon bearing Government of India security of face value Rs. 100 and residual maturity between 11 and 15 years on the expiry of futures contract. The underlying security shall be decided by stock exchanges in consultation with the Fixed Income Money Market and Derivatives Association (FIMMDA). Currently (in March 2018), the following GoI securities fall in this category: 6.79% bond due on 26th Dec 2029, 7.88% bond due on 19th Mar 2030, 7.61% bond due on 9th May 2030 and 6.68% bond due on 17th Sep 2031. Option B - Notional security The underlying shall be coupon bearing notional 13-year Government of India security with a face value of Rs. 100. For each contract, there shall be basket of Government of India securities, with residual maturity between 11 and 15 years on the day of expiry of futures contract, with appropriate weight assigned to each security in the basket. The underlying security shall have coupon with semi-annual compounding. Exchanges shall disclose criteria for including securities in the basket and determining their weights such as trading volumes in cash market, minimum outstanding etc. **Trading Cycle:**Three serial monthly contracts and Three serial quarterly contracts of the cycle March / June / September / December **Settlement:** Option A: The contract shall be cash-settled in Indian rupees. The final settlement price shall be arrived at by calculating the

	volume weighted average price of the underlying security based on prices during the last two hours of the trading on Negotiated Dealing System-Order Matching (NDS-OM) system. If less than 5 trades are executed in the underlying security during the last two hours of trading, then FIMMDA price shall be used for final settlement. Option B: (a) The contract shall be cash-settled in Indian rupees. The final settlement price shall be based on average settlement yield which shall be volume weighted average of the yields of securities in the underlying basket. For each security in the basket, yield shall be calculated by determining weighted average yield of the security based on last two hours of the trading in NDS-OM system. If less than 5 trades are executed in the security during the last two hours of trading, then FIMMDA price shall be used for determining the yields of individual securities in the basket.

Notional security does not exist and is not traded. Accordingly, for the purpose of delivery, any of the eligible securities (explained in Section 5.7) are allowed to be substituted for the notional underlying after adjusting the delivery quantity through a "Conversion Factor" (explained in Section 5.6). However, currently no Exchange trades a notional security with physical settlement and therefore the procedure for physical settlement is only for reference. All the three Exchanges (NSE, BSE and MSEI) trade bond futures with actual underlying securities only.

5.2 Contract Amount (or Market Lot)

Contract Amount (or Market Lot) is the minimum and multiple of trade size. It is Rs 200,000 of face value of GOI securities which is equivalent to 2000 units of that security. Because the face value will always be an integral multiple of Rs 2 lakhs, we cannot buy or sell for amounts like Rs 3 lakh, Rs 5 lakh, etc. In contrast, the market lot in the cash market of wholesale debt market is Rs 5 Cr (which is equal to 250 futures contracts).

The face value and market value are linked by the market price. In both cash and futures markets, the prices are quoted for Rs 100 face value so that the relation between face value and market value is:

$$\text{Market Value} = \text{Face Value} \times (\text{Market Price} / 100)$$

or the market value of one contract is 2,000 times the quoted price. Thus, if the price is 106.10, the face value of 200,000 will have a market value of:

$$200{,}000 \times (106.10/100) = 212{,}200 \text{ or } 2{,}000 \times 106.10 = 212{,}200.$$

5.3 Contract Months, Expiry / Last Trading Day and Settlement Day

Contract Month (also known as Expiry Month) is the month in which the contract ceases trading. On any trading day, there will be multiple Contract Months that expire in different months. Expiry Date (also known as Last Trading Day or LTD) is the day in Contract Month on which trading ceases. Settlement Day (SD) is the day on which the contract is settled. (NOTE: in overseas Exchanges, Expiry Date corresponds to the Settlement Date and is different from LTD. However, in India, SEBI uses Expiry Day and LTD as synonyms and they are distinguished from SD). The following table shows the particulars allowed by SEBI:

	91-day bill futures	**10-year bond futures**	**6-year bond futures**	**13-year bond futures**
Contract Months	Three serial monthly contracts followed by one quarterly contract of the cycle March / June / September / December	Three serial monthly contracts followed by three quarterly contracts of the cycle March / June / September / December	Three serial monthly contracts followed by three quarterly contracts of the cycle March / June / September / December	Three serial monthly contracts followed by three quarterly contracts of the cycle March / June / September / December
Last Trading Day (LTD)	Last Wednesday of expiry month at 1:00 PM (or, the previous trading day, if it is a holiday)	Last Thursday of Contract Month (or, the previous trading day, if it falls on a holiday)	Last Thursday of Contract Month (or, the previous trading day, if it falls on a holiday)	Last Thursday of Contract Month (or, the previous trading day, if it falls on a holiday)
Settlement Day	Last business day of Contract Month	Next working day following LTD	Next working day following LTD	Next working day following LTD

5.4 Price Quotation, Tick Size and Trading Hours

Price quotation refers to the style of quoting the contract price; and tick size is the minimum change in price. The tick size for all these contracts is Rs 0.0025. The price quotation for T-bill is 100 minus the *discount yield* (which is different from investment yield, see Section 2.6) and that for GOI security is price per 100 face value. For example, if the discount yield is 5%, then the price of T-bill futures will be: 100 – 5 = 95.0000. Given that the face value of one contract is equal to Rs 200,000 and given that tick size is 0.0025, the minimum change per contract will be:

$$200{,}000 \times 0.0025 / 100 = 5$$

Trading hours are aligned with those of NDS-OM, which is currently between 9:00 AM and 5:00 PM.

5.5Daily Settlement Price (DSP)

Daily settlement price (DSP) is the price at which margining and mark-to-market (see Unit 6) is implemented. Because of daily mark-to-market, the carry price of the contract changes every day. The following is the procedure for determining the DSP.

For 91-day bill futures

DSP is determined in one of the following ways in that order of preference:

(a) If there are at least five trades in the last 30 minutes of trading:

$$DSP = 100 - 0.25 \times Y$$

where Y is the weighted average yield price of trades, the weights being the number of contracts in the trade.

(b) If there are at least five trades in the last 60 minutes of trading:

$$DSP = 100 - 0.25 \times Y$$

(c) If there are at least five trades in the last 120 minutes of trading:

$$DSP = 100 - 0.25 \times Y$$

(d) Theoretical price will be determined by the Clearing Corporation in accordance with the disclosed procedure from the rates published by Fixed Income and Money Market Derivatives Association (FIMMDA).

For 6-year, 10-year and 13-yearbondfutures

DSP is the volume weighted average price (VWAP) during the last 30 minutes of trading in the futures market. If there is no trading during the last 30 minutes, DSP will be the VWAP during the last two hours in the cash NDS-OM market. If there are no trades during that period in the NDS-OM, DSP will be the price determined by FIMMDA.

5.6 Final Settlement Price (FSP)

Final settlement price (FSP) is the price at which the contract is settled on the SD. For 91-day bill futures, FSP is the weighted average discount yield (Y) in the auction of 91-day T-bill conducted by Reserve Bank of India (RBI) on the expiry date. The FSP is

$$(100 - 0.25 \times Y)$$

Note that 91 days is considered exactly one-fourth of the year (i.e. 0.25) in the formula above. For example, if the weighted average discount yield (Y) in the RBI auction is 5%, then the FSP will be

$$(100 - 0.25 \times 5\%) = 99.9875$$

The value of one contract, given its face value of 200,000 and given that the price is for 100 face value, will be

$$(200{,}000 / 100) \times 99.9875 = 199{,}975$$

For the cash-settled 6-year or 10-year or 13-yearactual bond, FSP will be the VWAP of the actual bond during the last two hours of trading in the cash market of NDS-OM. If less than five trades occur during that period, FSP shall be the price determined by

FIMMDA.

For the cash-settled 6-year or 10-year or 13-year notional bond, the following is the SEBI-specified procedure. It may be noted that since no Exchange currently trades such a contract, the discussion below is only for reference.

Step #1: Find the weighted average yield of each bond in the underlying basket during the last two hours of trading in the cash market of NDS-OM. If less than five trades occur during that period, use the FIMMDA-determined yield for each bond.

Step #2: Weigh the yields from individuals bonds from Step #1, the weights being the weights assigned to each bond in the basket by the Exchanges. Let this be settlement yield (Y), which is rounded to four decimal places.

Step #3. Convert the settlement yield (Y) into final settlement price (FSP), using the following formula.

$$FSP = \left[\frac{100}{\left(1+\frac{Y}{2}\right)^{2n}}\right] + \left[\sum_{k=1}^{2n} \frac{\left(100 \times \frac{C}{2}\right)}{\left(1+\frac{Y}{2}\right)^{k}}\right]$$

where C is the notional coupon for the underlying notional bond, n is 6 for 6-year IRF, 10 for 10-year IRF and 13 for 13-year IRF.

5.7 Delivery under physical settlement

Currently, no Exchange trades in physically settled bond futures. Therefore, the following discussion is for reference purpose only and no longer relevant to the current market practices.

To enable physical settlement for imaginary notional bond, other bonds of the central government are to be made eligible for delivery and are designated as Deliverable Bonds, which must satisfy specified criteria.

It is desirable to allow multiple securities for delivery because of two reasons. First, institutional investors generally adopt buy-and-hold strategy. Since the outstanding stock of a bond is much less compared to floating stock of equities, the bond will quickly lose liquidity in cash market, which in turn will affect the liquidity of futures. Second, given the low outstanding stock of bonds, market manipulators can easily create squeeze by simultaneously buying the bond in cash market and buying futures. It must be noted, however, that the facility to allow multiple securities for delivery will be effective only when they are not much different in their cost of delivery.

To make the notional bond and a Deliverable Bond equivalent in value, a Conversion Factor (also known as Price Factor) is employed, which is specific to each Deliverable Bond. Conversion Factor (CF) is the clean price (i.e. without accrued interest) of one unit face value of Deliverable Bond computed at the yield-to-maturity of 7% (semi-annual payment, 30E/360 day count) on the first calendar day of Delivery Month, after rounding down its remaining maturity to the nearest quarter-year. If there is a single quarter in the remaining maturity (i.e. broken period or stub), it is placed at the

beginning (i.e. front stub). This is a technical calculation and the Exchange will announce the CF for each Deliverable Bond when the contract is introduced for trading or few days before the trading for Contract Month commences. We may notice the following features of CF.

- For the same bond, the CF will be different for different Delivery Months because of change in remaining maturity of the Deliverable Bond from the first calendar day of different Delivery Months.
- CF will remain constant for a Delivery Month regardless of changes in yields over time. Changes in yield will drive changes in the price of Deliverable Bond (and futures price), but do not change the CF.
- For Deliverable Bonds whose coupon is less than the notional coupon (NC), the CF will be less than unity; for those with coupon of more than NC, the CF will be more than unity; for those whose coupon is NC, the CF will be unity.
- CF works perfectly only when the term structure is flat and at the level NC. If the term structure is flat and at this level, then the ratio of price-to-CF will be 100 for all deliverable bonds. Term structure is rarely flat and its shape will affect which of the Deliverable Bond will be delivered by the futures seller.
- As the term structure moves away from the NC, then the CF no longer adjusts the prices perfectly. As the yields rise above the NC, the prices of all bonds fall, but the price of the bond with the highest Modified Duration (MD) falls more, making it the candidate for delivery. As the yields fall below the NC, the prices of all bonds rise, but the price of the bond with the lowest MD rises the least, making it the candidate for delivery. In general, higher-MD bond will likely to be the candidate for delivery when the term structure steepens; and lower-MD bond, when the term structure flattens.
- As stated above, the MD of futures increases with the rising yields and falls with falling yields. This is called negative convexity, which is more pronounced when the deliverable basket contains bonds with wide range of MD and when the futures expiry is farther. This is the reason for curtailing the maturity of deliverable bonds into a narrow band. If the notional coupon is away from the current yields in the market, the switch in the deliverable bond unlikely and the futures contracts becomes virtually a contract on single underlying, and shows positive convexity.

Seller must notify the Clearing Corporation of his intention to deliver by 6pm on the second business day prior to the Expiry Date (which is the last business day of the Contract Month).

The delivery must be through SGL A/c or CSGL A/c (explained in Unit 6), and the intention to deliver must be notified on the last trading day. The settlement amount is computed after taking into account the Deliverable Security, Conversion Factor and accrued interest relevant to that security; and the final settlement price fixed by the Exchange. The amount of cash payable by buyer to seller, called invoice amount (IA), is computed as follows:

$$IA = \left[\left(SP \times CF \right) + AI \right] \times \frac{CA}{100}$$

where

SP: Final settlement price (per 100 of face value)
CF: Conversion factor applicable to that Deliverable Bond
AI: Accrued interest (per 100 of face value) on the Deliverable Bond
CA: Contract amount (or market lot), which is 200,000

The term in parentheses represents the settlement price (which is the market price) per unit of face value adjusted for the quality of Deliverable Bond with multiplicative CF. The second term in the square brackets is the interest accrual on the Deliverable Bond from the previous coupon date to the futures settlement date. The term outside the square brackets converts the settlement amount per one unit of face value (in the first equation) or per 100 units of face value (in the second equation) to the contract amount of one futures contract.

Cheapest-to-Deliver (CTD) Bond

The futures seller can deliver any of the Deliverable Bonds. In theory, the introduction of Conversion Factor for each Deliverable Bond should make the seller indifferent to any preference for particular bond. In practice, however, there is a particular bond (called the "cheapest-to-deliver" or CTD bond) that every futures seller will prefer to deliver. The reason for this preference is that the Conversion Factor does not change during the Delivery Month while the prices/yields of Deliverable Bonds do change during trading hours. Accordingly, the futures price will be tracking the cash market price of the CTD bond.

Sample Questions

1. The underlying for 10-year bond futures under the current regulations can be theoretically _____.
    a. Notional bond
    b. Actual bond
    c. Can be either (a) or (b) above
    d. None of the above

Ans: (c)

2. Which of the following is the last trading day for 10-year bond futures?
    a. Two business days after the first business day of the Expiry Month
    b. Two business days before the last business day of the Expiry Month
    c. Seven business days before the last business day of the Expiry Month
    d. None of the above

Ans: (d)

The last trading day for the 10-year bond futures is the Last Thursday of Contract Month (or the previous trading day if it falls on a holiday).

3. Which of the following is the settlement day for 10-year bond futures?
    a. Last business day of the Expiry Month
    b. Two business days after the last trading day
    c. Both (a) and (b) above
    d. None of the above

Ans: (d)

Settlement day for 10-year bond futures is the next working day following the last trading day.

4. Which of the following is correct about the Conversion Factor?
    a. It adjusts the quantity of Deliverable Bond
    b. It adjusts the price of Deliverable Bond
    c. Both (a) and (b) above
    d. None of the above

Ans: (a)

5. What is the settlement method for 91-day bill futures?
    a. Cash
    b. Physical
    c. Can be cash or physical
    d. None of the above

Ans: (a)

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Chapter 6: Trading, Clearing, Settlement and Risk Management

LEARNING OBJECTIVES:

After studying this chapter, you should know about:

- Trading, clearing and settlement of interest rate derivatives on exchanges
- Order types and execution
- Margining and mark-to-market
- Clearing and Settlement
- Procedure for delivery

6.1 Operational Guidelines of Exchanges

Bill and bond futures (called "interest rate derivatives" in the circulars issued by the regulators) are traded, not as a separate segment, but as a part of Currency Derivatives segment. Currently, three Exchanges, namely, Bombay Stock Exchange (BSE), National Stock Exchange of India Ltd (NSE) and Metropolitan Stock Exchange of India (MSEI) are authorized by the regulator to trade in interest rate derivatives.

As is the norm for all derivatives Exchanges, the trading and settlement are conducted by two distinct legal entities: trading by Exchange and settlement (along with the associated process of Clearing) by Clearing Corporation (CC). The following are the clearing entities associated with different Exchanges in India.

Exchange	Clearing Corp
BSE	Indian Clearing Corporation Ltd (ICCL)
MSEI	Metropolitan Clearing Corporation of India Ltd (MCCIL)
NSE	National Securities Clearing Corporation Ltd (NSCCL)

Both the Exchange and CC do not deal with the buyers and sellers directly but through their "members". The members of Exchange are called Trading Members; and those of CC, Clearing Members. The following types of memberships are permitted under current regulations.

Membership type	Explanation
Trading Member (TM)	Member of Exchange but not CC so that it can only execute trades but settle them through a designated Professional Clearing Member (PCM). Trade execution can be for own account (called "proprietary trading") or for clients (called "client trading")
Trading-cum-Clearing Member	Member of both Exchange and CC so that it

(TCM)	can execute as well as settle trades. It can settle trades executed by other TMs, too.
Self-clearing Member (SCM)	Same as TCM but can settle the trades of own account or its clients but not the trades of other TMs.
Professional Clearing Member (PCM)	Member of CC only and settles trades of TMs.

The legal form of members can be individuals, partnerships, corporate bodies or banks, except for PCM, who can be only corporate bodies or banks.

The Clearing members have to meet the minimum net worth requirements set by the regulator from time to time. Besides the regulatory minimum net worth, Exchange/CC has additional requirement of deposit to be placed with them. The deposit is partly in cash and partly in qualified securities which are specified in advance and vary over time. If the member has membership of other segments (i.e. capital market, debt market, futures and options on equities) then the deposit requirement may be less.

Staff must qualify the NISM Certification program on interest rate derivatives.

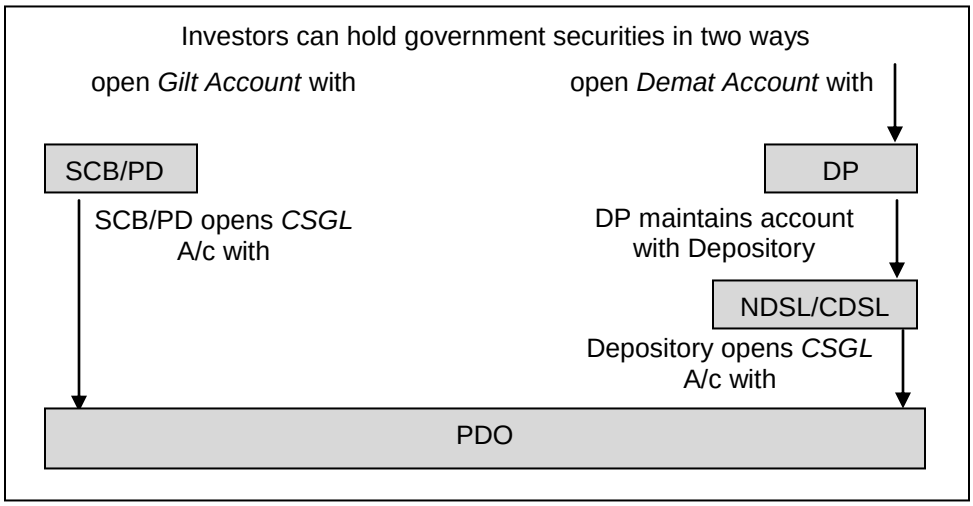
For the cash side of settlement, CC will pay or receive cash only through designated branches of designated banks called Clearing Banks. Therefore, TCM/SCM/PCM must open an account with one such designated branch. This account is called Clearing Account, which is subject to the following.

1. It should be used exclusively for making and receiving payments with CC
2. Members should authorize the Clearing Bank to allow CC to directly debit or credit amount to the Clearing Account of the member.
3. The shifting of Clearing Account to another Clearing Bank will require prior approval of CC

Like stocks and non-sovereign debt instruments, government securities are held in electronic book entries by a depository. However, the depository for government securities is the Public Debt Office (PDO) of RBI, and not the National Securities Depository Ltd (NSDL) and Central Depository Services (India) Ltd (CDSL).

PDO holds accounts only for Schedule Commercial Banks (SCB), Primary Dealers (PD) and few select financial institutions that maintain current account (for cash) with RBI; and this security account is called Subsidiary General Ledger (SGL) Account, which is the equivalent of demat account with NSDL and CDSL for equity and non-government debt instruments. Entities other than SCBs and PDs that want to hold government securities must open an account with a designated SCB or PD and this account is called Gilt Account. The SCB or PD holding government securities in Gilt Account for their constituents must in turn open a separate second account with PDO, which is called Constituent SGL (CSGL) Account or SGL II A/c. In other words, SCBs and PDs must separate their own holdings in government securities from those held on behalf of their constituents. The former are held in SGL A/c and the latter, in CSGL A/c. In other words, SCB/PD is the equivalent of Depository Participants (DP); and PDO is the equivalent of NSDL/CDSL.

Not all branches of SCBs/PDs open Gilt Accounts for holding government securities by their constituents. This is in contrast to the wider reach of Depository Participants of NDSL/CDSL. To enable wider participation of retail investors to invest in government securities, PDO has allowed NSDL and CDSL to maintain CSGL Account with it so that NSDL and CDSL can include the government securities of retail investors in their regular demat accounts through DPs. The following shows how the investors can hold government securities.



PDO requires that cash and securities are to be settled on delivery-versus-payment (DvP) mode: that is, both cash and securities are simultaneously settled by debit and credit to respective cash and securities accounts held with PDO and RBI. Similar DvP mode must be applied to the Gilt Account with SC, to enable which the same Branch of SCB must maintain both Gilt Account and cash account of the investors. PDs and DPs do not maintain any cash account for investors. Therefore, if the investor holds government securities in Gilt Account with a PD or in demat account with a DP, the DvP settlement cannot be implemented and therefore DvP norm does not apply. However, PD or DP must maintain a record of the particulars of cash account of the investor maintained with a bank.

Government securities can be also held as physical certificates. However, all entities regulated by RBI must hold their securities compulsorily in electronic book entry form in SGL Account (with PDO) or Gilt Account (with SCB/PD). When held in physical form, the ownership cannot be transferred by mere endorsement and delivery alone, but every transfer must be additionally registered in the books of PDO for the legal transfer of title.

Trading activity on the Exchanges in the IRF contracts will be synchronized and aligned with the secondary market trading on the NDS-OM platform. If there is any extension or early closure of the NDS-OM (as directed by RBI), a similar change will be effected in the Exchanges.

6.2 Order Types and Execution

Investor can control the price, time or circumstances in which the order is executed by specifying the order type. The following order types are permitted,

Parameter of control	Order types
To control the price at which order is executed	Market order, limit order
To control the time of order execution	Immediate or cancel, good till day
To control the circumstances of order execution	Stop-loss, stop-loss limit

Market order

It is an order to buy or sell at the *prevailing market* price. It must be specified as a combination of two inputs: market side + quantity. For example, "**buy** [market side] **2 contracts** [quantity]"

The advantage of market order is the guarantee of execution: it will be executed immediately. The disadvantage is the price: you have no control over the price at which it is executed.

Limit Order

It is an order to buy or sell only at the *specified* price or better. It must be specified as a combination of three inputs: market side + quantity + price limit. For example, "**buy** [market side] **2 contracts** [quantity] at **101.10** [limit]". For buy orders, the limit must be less than the current market offer price; and the order must be executed at the limit specified or lower. For sell orders, the limit must be higher than the current market bid price; and the order must be executed at the limit specified or higher. For example, if the current market price is 101.40/101.50, then

For buy order: the limit must be lower than 101.50 (say, 101.45) and the order must be executed at or lower than the limit (in this case, at or lower than 101.45)

For sell order: the limit must be higher than 101.40 (say, 101.45) and the order must be executed at or higher than the limit (in this case, at or higher than 101.45)

The advantage of limit order is that you can control the price at which it is executed. The disadvantage is the possibility of non-execution: the order may not be executed at all, if the limit specified is not tested.

Immediate or Cancel (IOC)

It is an order to execute the trade immediately. If it cannot be executed, it should be cancelled. It can be combined with limit order and partial execution is permitted. For example, the order is "Sell 10 contracts at 101.50 IOC". If there are buyers at 101.50 for only for 6 contracts, the order will be executed at 101.50 for 6 contracts, and the balance of 4 contracts will be automatically treated as cancelled.

Good Till Day

Also known as “day order”, it is a limit order that is kept in the market until the close of trading hours, at which any unexecuted portion will be automatically cancelled.

Stop-Loss Order

It is an order to exit from an existing trade if the market moves against the trade at a pre-defined loss. The stop-loss buy order is to exit from the short position currently held; and the stop-loss sell order is to exit from the long position currently held. The stop-loss requires a trigger price to be specified, which should be higher than current market offer price for stop-loss buy order; and lower than current market bid price for stop-loss sell order. The stop-loss order is activated only when the trigger price is hit in the market, and once it is activated it becomes a market order.

For example, consider the buy trade already executed at price of 101.50. To ensure that you should not lose more than 0.50 on the trade, you will place a stop-loss sell order with trigger price at 101.00 (“stop-loss sell 2 contracts trigger price 100.00”).

You can also combine stop-loss order with a limit price, which is called “stop-loss limit order”. For example, you may specify “stop-loss sell 2 contracts trigger price 100, limit price 99.90”. This order will be activated when the market bid price touches 100 and will be executed at a price of 99.90 or higher. Stop-loss limit order has the risk of not being executed at all, if the market moves quickly, after hitting the trigger price.

When the order is input, the following information is required to be specified.

1. Contract ID, which consists of the derivative type (i.e. futures or option), underlying (i.e. bill or bond), and expiry month.
2. Market side (i.e. buy or sell)
3. Quantity (i.e. number of contracts)
4. Order type
5. Whether it is proprietary (“pro”) trade of the Trading Member or client (“cli”) trade. If it is a client trade, the client code that is available with the Exchange.

6.3 Spread Orders

Spread order consists of simultaneous buy and sell of two different instruments. For futures, there are two kinds of spread orders: inter-commodity spread and calendar spread.

Inter-commodity spread consists of buying futures on one underlying and selling futures on another for the same expiry month and for the same quantity. For example, “buy 5 contracts March-2018 bill futures and sell 5 contracts of March-2018 bond futures.

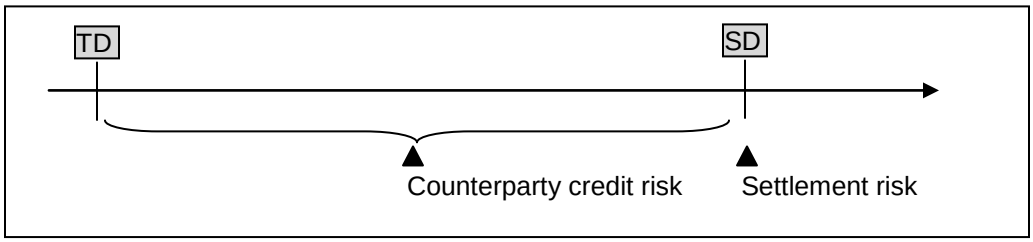
Calendar spread consists of buying and selling futures on the same underlying but different expiry months and for the same quantity. For example, “buy 5 contracts March-2018 bill futures and sell 5 contracts of April-2018 bill futures. Calendar spreads

are more popular than inter-commodity spreads and Exchanges allow the facility to enter calendar spread as a single order (instead of entering two separate orders for each expiry month). Recall that there are three expiry months on any trading day. The contract with the shortest expiry date is the "near" month; that with the longest expiry date is the "far" month; and that whose expiry date is between the near and far is the "mid" month. Similarly there are three expiry quarters on any trading day.

Calendar spreads have lesser margin requirements (see Sec 6.4). The margin for both trades in the spread will not be double but less than the margin required for one of them. The reason is that the risk in calendar spreads is less than the outright trade. Both contracts tend to move in the same direction, though not by the same extent. Since one is bought and the other is sold, the profit on one will more or less offset the loss on the other.

6.4 Margining and Mark-To-Market

Margining and mark-to-market are tools to mitigate counterparty credit risk and settlement risk of derivatives. Counterparty credit risk is the failure of counterparty before the trade is due for settlement; and settlement risk is the failure of counterparty when the trade is due for settlement. In other words, counterparty credit risk arises between trade date (TD) and settlement date (SD); and settlement risk arises on SD.



The size of counterparty credit risk is equal to the replacement cost of the trade because if one party fails before the settlement date, the other party will have to replace the trade in the market with another party at the prevailing market price. The size of settlement risk is equal to the trade value because one party performs (by paying cash or delivering security) while the other does not. We may say that counterparty credit risk transforms itself into settlement risk on settlement date. Settlement risk is mitigated by delivery-versus-payment mode of settlement: both parties simultaneously exchange cash and security. If one party does not perform his obligation, the other will withhold his.

Counterparty credit risk is mitigated by mark-to-market and margining. Mark-to-market consists of daily valuing the position at the official Daily Settlement Price (see Sec 5.5). The difference between the carry price and Daily Settlement Price is settled in cash, and the position is carried forward to the next day at the Daily Settlement Price. In other words, any profit/loss made is settled on daily basis instead of accumulating it until the settlement date. Because of this daily mark-to-market, the maximum loss from counterparty credit is limited to the price change over a single day instead of price

change over the life of the contract (which could be much higher). Even this reduced size of counterparty credit risk (equal to the price change over a single day) is eliminated by collecting it upfront from each party to the trade, and this is called "initial margin". Both buyer and seller will have to pay initial margin upfront before the trade is initiated. Initial margin is computed through a model called "value-at-risk" (VaR) for each trade, and the total initial margin required for all trades in an investor account is computed through what is called SPAN margining methodology.

Value-at-risk (VaR)

Value-at-risk (VaR) is a measure of maximum likely price change over a given interval (called "horizon") and at a given confidence level (called "percentile"). Two facts about VaR should be noted. First, VaR does not tell about direction of price change. Second, VaR is not an exact measure but a "equal to or less than" measure. For example,

VaR (1-day, 99%) = Rs 10.

The correct interpretation of such statement is that in the next one day ("horizon"), the price change will be:

Less than or equal to Rs 10 in 99 out of 100 days ("percentile); or equivalently
More than Rs 10 in the balance 1 out of 100 days

VaR for each security is then converted into "scan range" by multiplying with the Contract Amount (or "market lot") of the futures contract. For example, if VaR (1-day, 99%) = 10 for the security and the market lot is 1,000 securities, then the scan range for the futures is: $10 \times 1{,}000 = 10{,}000$. This is the amount of maximum likely change in contract value over next one day in 99 out of 100 days. Therefore, this is the upfront initial margin the Clearing Corporation would demand from the investor. However, the margining process is much more refined under SPAN margining system.

VaR will be slightly higher for short positions than for long positions. The reason is that the price can theoretically rise to infinity but cannot fall below zero. As a result, the possible loss on short positions is infinity (because price can rise to infinity) while the possible loss on long positions cannot be higher than current price (because price cannot fall below zero).

SPAN margining: initial margin and variation margin

SPAN is an acronym for Standard Portfolio Analysis, which is a margining system that is devised and owned by Chicago Mercantile Exchange (CME) Group, the largest derivatives Exchange in the world, but is allowed to be used for free by others. Most derivatives Exchanges follow SPAN margining today.

SPAN margining uses VaR to compute initial margin but improves upon it with two modifications. It generates 16 "what-if" scenarios. Remember that VaR is not an exact measure but the maximum likely change at a given confidence level. To make it realistic, SPAN assumes that: (1) price may not change at all; (2) price may go UP by one-third of scan range; (3) price may go DOWN by one-third of scan range; (4) price may go UP by two-thirds of scan range; (5) price may go DOWN by two-thirds of scan range; (6) price

may go UP by full scan range; (7) price may go DOWN by full scan range. These seven scenarios are considered separately for volatility UP and volatility DOWN cases, giving a total of 14 scenarios, as follows.

Price change	Volatility UP	Volatility DOWN
No change		
Up by 1/3 of scan range		
Up by 2/3 of scan range		
Up by full scan range		
Down by 1/3 of scan range		
Down by 2/3 of scan range		
Down by full scan range		

Volatility is relevant only for options, not for futures. Therefore, for futures, both columns (volatility up and down) will have the same value. Two more scenarios are extreme price moves: extreme UP and extreme DOWN. Remember that VaR indicates the maximum likely change in 99 out of 100 cases. It does not tell the change in all 100% of cases. To account for the balance 1% of the case, extreme price move is assumed. The extreme price moves are defined by Exchanges. It is usually set at a specified percentage of specified multiples of scan range. For example, 35% of two scan ranges, etc. Thus, if the scan range is 10,000 and extreme price move is 35% of two scan ranges, then the extreme price move will be$35\% \times (2 \times 10{,}000) = 7{,}000$.

The second and more important feature of SPAN margin is that it considers the entire portfolio of an investor for computing the portfolio-wide margin. The margin is not computed for each position separately. The portfolio-wide margin incorporates the benefits of diversification, which are particularly important for inter-commodity and calendar spreads (see Sec 6.3). If the investor is long in one instrument and short in a related instrument, there will be risk offset because profit on one will be offset by loss on the other in every scenario. In other words, the margin requirement for spread should not double the margin for one but should be less than the margin for one of them.

All the outstanding positions of an investor are analyzed in the 16 scenarios. The largest loss is the initial margin required for the portfolio of outstanding positions. Three more adjustments are made to the portfolio-wide margin derived as above: calendar spread charge, inter-commodity spread credit and short option minimum margin.

Calendar spread charge is the amount added to the margin derived as above. This amount is an adjustment for the fact that long and short positions on the same underlying but for different expiry months may not change in value by the same extent. For example, you are long on first month and short on second month. The first month price moves DOWN by 1% but the second month price moves DOWN by only 0.9%. The loss and profit on the first and second months, respectively, are fully offset but there is a residual loss of 0.1%. The calendar spread charge is meant for such risk.

Inter-commodity spread credit is the amount that is deducted from the portfolio-wide margin derived as above. The credit reflects the facts that the related underlying tend to move together in the same direction (called "positive correlation"). For offsetting positions in different but related underlyings, the actual risk is lowered and therefore inter-commodity spread credit is given.

Short option minimum margin applies only if there are short option positions in the portfolio. Because short options have higher risk, a minimum margin is specified regardless of the portfolio-wide margin derived as above.

There is a contract-level minimum margin specified by the regulator. If the initial margin requirement under SPAN margining is less than the regulatory-specified minimum margin, the margin requirement is set at the regulatory-specified minimum margin.

Summary of SPAN margining

1. Compute the VaR (1-day, 99%) for each underlying in the portfolio
2. Compute the scan range for each futures contract
3. Generate 16 what-if scenarios for the entire portfolio of investor (only seven of them are relevant for futures contracts)
4. Find the largest loss in each scenario and select it as the initial margin for the portfolio
5. Add the calendar spread charge (if applicable) to the amount in Step #4
6. Deduct the inter-commodity spread credit to the amount in Step #5
7. Find the short option minimum margin and set the margin at the minimum of short option minimum margin and the amount in Step #6. (It applies only if there are short options in the portfolio)
8. Find the minimum margin specified by regulator and set the initial margin at the minimum of regulatory minimum margin and the amount in Step #7.

Example of SPAN margining

For simplicity, we will assume that there is only one futures contract in the portfolio. The initial margin for the futures contract is 10 for long positions and 11 for short positions.

You bought 10 contracts at a price of 101. The upfront initial margin you would have already paid before the trade execution will be: $10 \times 10 = 100$.

At day-end, the Daily settlement price is 102. The mark-to-market process results in a profit of: $10 \times (102 - 100) = 20$. This amount is credited to you account and the contract is carried forward to next day at the price of 102. The balance (called "equity") available in the margin account will be 120, consisting of initial paid earlier of 100 plus the mark-to-market profit of 20.

VaR model is updated at day-end, and the new initial margin for next day is Rs 13 for long and Rs 14 for short positions. The initial margin has gone up since yesterday because the riskiness of the security has gone up. The initial margin required for the outstanding position will be: $10 \times 13 = 130$. As against this latest margin requirement,

the “equity” in margin account is 120, the short fall of 10 has to be paid by next day, and this amount is called “variation margin”.

Extreme loss margin and delivery margin

Besides the initial margin and variation margin under SPAN margining, there are two more margins implemented by the Clearing Corporation. They are extreme loss margin and delivery margin. Extreme loss margin is applicable to the Clearing Member and is the amount deducted from liquid assets in real-time. It is specified as a percentage of Open Position (explained in Sec 6.5). Delivery margin is applicable for physical delivery of security (explained in Sec 6.6).

The following are the current margins for 91-day bill futures and cash-settled 6-year, 10-year and 13-year bond futures:

Margin	**91-day bill futures**	**10-year bond futures**	**6-year bond futures**	**13-year bond futures**
Initial margin	VaR (99%, 1-day) subject to a minimum of 0.10% on the first day of contract and 0.05% thereafter	VaR (99%, 1-day) subject to a minimum of 2.8% on the first day of trading and 1.5% thereafter	VaR (99%, 1-day) subject to a minimum of 2.8% on the first day of trading and 1.5% thereafter	VaR (99%, 1-day) subject to a minimum of 2.8% on the first day of trading and 1.5% thereafter
Extreme loss margin	0.03% of the value of the gross open positions	0.50% of the value of the gross open positions	0.50% of the value of the gross open positions	0.50% of the value of the gross open positions

For calendar spread positions, the following are the initial and extreme loss margins:

Margin	**91-day bill futures**	**10-year bond futures**	**6-year bond futures**	**13-year bond futures**
Initial margin	Rs 100 for 1 month; Rs 150 for 2 months; Rs 200 for 3 months; and Rs 250 for 4 months and beyond;	Rs 1,500 for 1 month; Rs 1,800 for 2 months; Rs 2,100 for 3 months; and Rs 3,000 for more than 3 months	Rs 1,500 for 1 month; Rs 1,800 for 2 months; Rs 2,100 for 3 months; and Rs 3,000 for more than 3 months	Rs 1,500 for 1 month; Rs 1,800 for 2 months; Rs 2,100 for 3 months; and Rs 3,000 for more than 3 months
Extreme loss margin	0.01% of the value of the far month contract	0.01% of the value of the far month contract	0.01% of the value of the far month contract	0.01% of the value of the far month contract

Margining between client and Trading Member: maintenance margin

Clearing Corporation revised the SPAN risk parameters six times within a day: at the beginning of day, at 11:00am, at 12:30pm, at 2:00pm, at 3:30pm and at the end-of-day. It pays and receives variation margin with the Clearing Members daily. However, such daily payment and receipt of variation margins from between clients and Trading Members is not practical because there are thousands of clients for each trading member; and the logistics of margin calls and payments on a daily basis becomes almost impossible. Therefore, a different form of margining is applied between Trading Member and its clients, which is different from SPAN margining.

If the SPAN margining says that initial margin is 10, the trading member will collect from client more than that amount, say Rs 20; and defines another margin called "maintenance margin", which may be set at lower amount, say, Rs 15. There will not be any margin calls on the client as long as the equity remains at higher than the maintenance margin. The trading member will make a margin call on the client only when the equity falls below the maintenance margin. This reduces the administrative work of margin calls and payments. In contrast, SPAN margining has no concept of maintenance margin.

6.5 Clearing and Settlement

Clearing Corporation conducts the multilateral netting of obligations for both cash and securities. The netting is applied at the level of Clearing Member (CM). The net position (separately for cash and securities) for each Clearing Member is called the Open Position, which is settled with the Clearing Corporation. The following are the rules for deriving the Open Position for a Clearing Member.

a) For each Trading Member attached to the CM, separate the proprietary and client trades.

b) For the proprietary trades of the Trading Member, offset the long and short positions into a single net position. The net position will be either long or short, but not both.

c) For client trades of the Trading Member, offset the long and short positions into a single net position for each client separately, but not across the clients. In other words, the buy trades of one client cannot be offset with the sell trades of another client. If one client has net buy position and another client has net sell position, they must be shown separately. Accordingly, every client will have either net long or net short position.

d) Sum the net position at (b) and (c) above separately for net long and net short positions.

e) Repeat the above steps from (a) to (d) for all other Trading Members of the CM

f) Sum the Trading Member-wise net long and net short positions across at (d) above. This is the net long and net short positions for the CM.

The following example illustrates the Open Position for Clearing Member A (CM-A), who clears and settles for Trading Member A (TM-A) and Trading Member B (TM-B). TM-A has Client #1 and #2 and TM-B has Client #3 and Client #4.

		TM-A			TM-B		
		Proprietary	Client #1	Client #2	Proprietary	Client #3	Client #4
Buy	Securities	12	26	35	115	58	13
	Cash	115	258	345	1,135	564	128
Sell	Securities	8	19	38	114	55	16
	Cash	83	160	381	1,131	551	160
Net	Securities	4	7	–3	1	3	–3
	Cash	–32	–98	36	–4	–13	32

Given the above trades, the Open Position for the CM-A is computed as follows.

	Buy / Long		Sell / Short	
	Securities	Cash	Securities	Cash
TM-A	4+7 = 11	–32–98 = –130	–3	36
TM-B	1+3 = 4	–4–13 = –17	–3	32
Total	15	–147	–6	68

The above is repeated for all Clearing Members, and the Open Position for each is derived as above. Consider the following example.

	Buy / Long		Sell / Short	
	Securities	Cash	Securities	Cash
CM-A	15	–147	–6	68
CM-B	25	–252	–15	148
CM-C	13	–134	–24	245
CM-D	6	–61	–12	119
CM-E	9	–91	–7	58
CM-F	14	–129	–18	176
Total	82	–814	–82	814

The total long position (for securities as well as cash) must be exactly equal to the total short position (for securities as well as cash). If not, there is an arithmetic mistake in netting calculations. The total long position must be exactly equal to the total short position because every trade requires a buyer and a seller so that the market as a whole has neither net long nor net short position.

Settlement

Settlement follows clearing and consists of payment of cash versus delivery of securities after multilateral netting in the clearing. Physical settlement means exchange of cash for the security. Physical settlement does not mean that every sell trade during contract's life results in physical delivery. The seller can always close ("square up") his position with an offsetting buy trade, but it must be done before the close of business on the Last Trading Day (see Sec 5.3). In case of physical delivery, the Open Position at the close on Last Trading Day must be settled with physical delivery of any of the Deliverable Securities (see Section 5.7).

Bond futures can be either cash settled or physically settled as per the current guidelines. However no exchange has physical settlement of Bond Futures available. The Bond futures that are currently traded are all cash settled. All open positions on the last trading day of the futures contract shall be marked to the final settlement price for the relevant futures contract and shall be cash settled. The profit/ loss resulting there from shall be paid to/ received from such member in accordance with the laid down settlement procedures in this regard.

Every Clearing Member must discharge his obligation i.e.,

(i) In case of Physical Settlement: Deliver securities for sell trades and pay cash for buy trades before he is entitled to receive securities or cash from the counter-party (i.e., pay-in before pay-out), and

(ii) In case of Cash Settlement: Settle his cash obligations first before he is entitled to receive his cash receivables (i.e., pay-in before pay-out).

This is called "pay-in" first and "pay-out" later, both occurring on the same day with few minutes or hours between them. Thus, the settlement is not the delivery-versus-payment (DvP) type practiced for the settlement of government securities which are settled in the SGL A/c at PDO (see Section 6.1).

6.6 Procedure for Delivery

Currently all Bond Futures are all cash settled, hence the following is only for study and reference.

For the Open Position on the Last Trading Day, the seller must notify the Clearing Corporation his intention to deliver by 06:00PM on the Last Trading Day (which is two business days prior to the last business day of Contract Month), which is also called, for the purpose of settlement, the "Day of Intention". The deadline of 06:00 PM is for the Clearing Member, who may advance this deadline to its Trading Members, who in turn may further advance it to its Clients.

The Notice of Intent to Deliver must include the details of the Deliverable Bond. Seller may deliver different Deliverable Bonds, provided each of them is in multiples of Contract Amount (or market lot), which is Rs 2 lakhs in face value. For example, if the seller has to deliver two contracts (i.e. total face value of Rs 4 lakhs), he can deliver Rs 2

lakhs of Deliverable Bond A for one contract and another Rs 2 lakhs of Deliverable Bond B for the other. He cannot deliver Rs 3 lakhs of Deliverable Bond A and Rs 1 lakh of Deliverable Bond B. In practice, of course, all sellers will be delivering the same Deliverable Bond, which is the Cheapest-to-Deliver (CTD), as explained in Section 5.7.

If the seller fails to serve the Notice of Intent to Deliver by the stipulated time either for full Open Position or part of it, the failed quantity will be taken into Auction Settlement (explained below).

Allocation to Buyer

At the client-level, Clearing Corporation will assign the intentions from the sellers to the buyers, at the client-level, starting from longest maturity/age. If for a maturity/age, the total deliveries are less than the total buy quantity, then the allocation is done randomly.

Clearing Corporation will finalize and announce the security delivery Open Position at the Clearing Member level by 08:00PM on the Day of Intention (which is also the Last Trading Day for the contract).

Delivery Margin

Delivery margin is collected on the Day of Intent (which is the Last Trading Day) after the intention to deliver and allocations are completed. The margin amount is the VaR margin computed on the invoice price (which includes the accrued interest and conversion factor, unlike initial margin that does not include them) plus 5% of the face value of the security to be delivered. The delivery margin is applicable from the Day of Intention and released after the settlement is completed, and is collected from both buyer and seller. The mark-to-market margin is applied on the closing price of the security that is delivered.

If the seller fails to deliver the notice of Intention to Deliver, the VaR margin is computed on the invoice price of the costliest security in the basket of Deliverable Bonds, and the mark-to-market is applied on the price of this security.

Security Settlement

Clearing Corporation will receive and deliver Deliverable Bonds either in SGL Accounts with PDO or through the demat accounts system of NDSL/CDSL.

Procedure for pay-in of securities through SGL:

On the settlement day, Clearing Member (or its Bank holding CSGL Account) must transfer the security through the Negotiated Dealing System (NDS) operated by PDO.

Clearing Corporation will confirm each such transfer in the NDS; and the pay-in for securities must be completed before 11:00 AM on the settlement day.

For the pay-out, Clearing Corporation will transfer the securities through the NDS, and the Clearing Member (or its Bank holding CSGL Account) must accept

the transfer in the NDS.

Procedure for pay-in of securities through NSDL/CDSL:

On the settlement day, Clearing Member must transfer the security in its Settlement Pool Account maintained with a Depository Participant (DP) before the cut-off time specified by NDSL/CDSL. Clearing Member can use the same Settlement Pool Account of Capital Market segment for bond futures, too.

For the pay-out, Clearing Corporation will transfer the securities in its Settlement Pool Account of the Clearing Member.

The timing for pay-in and pay-out are the same as those applicable for Capital Market segment.

Seller can early pay-in (EPI) the securities before the scheduled pay-in time, which will help reduce the delivery margin.

Settlement of Cash Leg

Cash is settled through the Clearing Banks in the same account applicable for the currency derivatives. The timings of pay-in and pay-out are the same as that applicable for the Capital Market segment.

Auction Settlement

Auction settlement is a special settlement and distinguished from “normal” settlement. It applies on two occasions. First, seller fails to notify the Intent to Deliver. Second, there is a short-delivery of securities on the settlement day (that is, seller notifies the delivery but fails to deliver the full quantity).

When there is a failure to notify the Intent to Deliver, the auction is conducted on the first business day after the Day of Intention, and the result of auction is added to the settlement obligation due on the settlement day (which is one business day after the auction day).

When there is a short-delivery on the settlement day, the shortage is auctioned on the same day. This is called “buy-in” in which the Clearing Corporation initiates (hence called the “Initiator” in the buy-in) the auction; and any Trading Member can participate in the auction as “Solicitor”. Trading Member can place only sell order and only Limit Order (see Sec 6.2) in the auction. The price range applicable for the auction market is plus or minus 5% of the Base Price (explained in Section 7.1); and the Base Price is the latest price for that security published by Fixed-income and Money Market Derivatives Association (FIMMDA) and broadcast by the Clearing Corporation. The result of the buy-in is settled on the first business day after the auction date. The following shows the time line for settlement of securities.

Day	Description
Day of Intent (T)	This is also the Last Trading Day, which is two business days prior to the Settlement Day. Clearing Member must submit the Intent to Deliver by 06:00 PM; and Clearing Corporation will publish the Security Delivery Settlement Report by 08:00 PM
T + 1	Auction for failure to notify the Intent to Deliver. Obligations from the auction are added to the Security Delivery Settlement Report published on the Day T
T + 2	This is the Settlement Day, which is the last business day of the month and two days after the Day of Intention (T). Pay-in and pay-out of securities and cash occurs on this day, and buy-in auction is held for short-deliveries.
T + 3	This is the first business day following Settlement Day (or third business day after the Day of Intent) on which the buy-in auction (held on T + 2) is settled.

In case of auction, the invoice amount for the short-delivery, which is called "Valuation Debit", is debited to the defaulting member's account from the Security Delivery Settlement Report. Further, the defaulting member will pay the sum of following amounts in cash.

1. Amount at the auction price with accrued interest computed up to auction settlement day (T+3);
2. The difference between the original invoice amount and the auction amount, if the latter les less than the former. This ensures that the defaulter will not benefit from any favourable price change to him between T and T+2 days.
3. A penalty of 2% of the face value of the short-delivery amount, which shall be passed on to the buyer-client

Close-out

It is possible that the auction is unsuccessful: that is, there is no seller in the auction for the short-delivery amount or auction is successful but the seller in auction failed to deliver the security. In such case, the transaction is "financially closed-out" by the Clearing Corporation, as follows.

(1) Unsuccessful auction

The defaulting member's account is debited for cash at the original invoice amount plus a penalty of 5% of the face value of short-delivery amount, which will be passed on to the original buyer-client.

(2) Auction successful but the seller in auction fails to deliver

The defaulting member's account is debited for cash at the invoice amount in auction plus a penalty of 3% of the face value of short-delivery amount, which will be passed on to the buyer-client.

Sample Questions

1. Which of the following statements is true?
    a. **Clearing precedes settlement**
    b. Settlement precedes settlement
    c. Settlement precedes trade
    d. None of the above

Ans: (a)

2. Which of the following statements is true for Netting?
    a. Proprietary trades are offset
    b. Buy and sell trades of the same client are offset
    c. **Both (a) and (b)**
    d. None of the above

Ans: (c)

3. Which of the following statements is true for Netting?
    a. Buy and sell trades of the different clients are offset
    b. Client trades are offset with proprietary trades
    c. Both (a) and (b)
    d. **None of the above**

Ans: (d)

4. Initial margin is paid by _____.
    a. Buyer alone
    b. Seller alone
    c. **Both buyer and seller**
    d. None of the above

Ans: (c)

5. Mark-to-market margin is paid by _____.
    a. Buyer
    b. Seller
    c. **Whichever party that have negative value on Open Position**
    d. None of the above

Ans: (c)

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Chapter 7: Regulations and Compliance

LEARNING OBJECTIVES:

After studying this chapter, you should know about:

- Role of various regulators in interest rate derivatives market
- Restrictions on buying and selling of interest rate derivatives by residents and non-resident investors
- Position limits for T-bills and T-bond futures
- Role of FIMMDA in fixed income and derivatives markets in India
- Accounting standards for derivatives contracts

7.1 Role of Various Regulators

Like currency derivatives, interest rate derivatives are jointly regulated by Reserve Bank of India (RBI) and Securities and Exchange Board of India (SEBI). Within the statutory regulations of RBI and SEBI, the Exchanges and Clearing Corporations will frame the operational rules and procedures under their bye-laws. In addition to these, there are rules and procedures governed by various statutes and administered by specified bodies, including the Institute of Chartered Accountants of India (ICAI). The following shows the summary of statutory regulations and operational rules.

Entity	Authority/Statute	Scope
RBI	Government Securities Act 2006	All dealings in government securities
	Reserve Bank of India Act 1934; and Banking Regulation Act 1949	All dealings by RBI-supervised entities
SEBI	Securities Contract (Regulation) Act 1956; and SEBI Act 1992	All exchange-traded contracts
Exchanges	Bye-laws of the Exchange	Operational rules and procedures for trading, settlement & risk management
Depositories	Depositories Act 1996	Demat accounts
ICAI	Chartered Accounts Act 1949; and Companies Act 1956	Accounting and disclosure on use of derivatives by corporations

RBI's role in regulation of government securities is primary and fundamental and covers all activities while that of SEBI is limited to the Exchange-traded contracts on them.

RBI

Anything related to the government securities, both in primary and secondary market, is primarily regulated by RBI. In addition, RBI regulates the investment in debt securities by foreign institutional investors.

Product: The product features, deliverable bonds and settlement method are jointly defined by RBI and SEBI.

CSGL Account: Under the Government Securities Act 2006, the following entities are allowed to open Constituent Subsidiary General Ledger (CSGL) Account (see Sec 6.1) with Public Debt Office (PDO), RBI on behalf of their constituents, who maintain Gilt Account.

- Scheduled commercial banks
- Primary dealers
- Scheduled urban cooperative banks that satisfy the following three criteria: (a) minimum net worth of Rs 200 Cr; (b) minimum capital to risk-adjusted asset ratio (CRAR) of 10%; and (c) belong to the States that have signed MOU with the RBI
- Scheduled state cooperative banks that have a minimum net worth of Rs 100 Cr
- Two depositories in India (namely, NSDL and CDSL)
- Clearing Corporation of India Ltd (CCIL) and other Clearing Corporations notified by RBI
- Stock Holding Corporation of India Ltd (SHIL)
- National Bank for Agriculture and Rural Development (NABARD)

The CSGL Account Holder must ensure the following:

- The "Know Your Customer" norms are applied to the Gilt Account Holder (GAH)
- GAH is entitled to hold government securities under the General Loan Notification and specific loan notification issued by RBI
- GAH maintains only one Gilt Account. A suitable declaration to this effect must be obtained from the GAH before the account is opened. However, GAH may open an additional depository account with the depositories.
- Every debit in Gilt Account would require authorization from GAH, and the right to set off cannot be applied in the Gilt Account.
- Prior permission of RBI is required for the following value-free-transfer (VFT): (a) transfer to own account with depositories; (b) transfer for margining purposes; (c) transfer of Gilt Account from one CSGL holder to another

Restrictions on resident and non-resident investors: as specified in Sec 7.2.

SEBI

Within the broad regulatory framework specified by RBI, SEBI will further specify the regulations governing the Exchange-traded interest rate futures, as follows.

Membership Eligibility

There is no separate membership facility for interest rate futures, and membership in the Currency Derivatives Segment of Futures & Options will automatically enable trading in interest rate futures. The minimum net worth as of the latest balance sheet should be Rs 1 Cr for Trading Member (TM) and Rs 10 Cr for Clearing Member (CM).

Product Features: as specified in Unit 5

Position Limits: as specified in Sec 7.3

Margining and risk management: as specified in Sec 6.4 and 6.5.

Surveillance and Disclosure: The Exchange and Clearing Corporation will conduct the back-testing for the effectiveness of margining method twice in a year and communicate the results to SEBI.

Exchange and Clearing Corporation

Within the regulatory framework specified by SEBI, the Exchange and Clearing Corporation will specify the detailed rules and procedures for trading, clearing, settlement (including auction settlement) and risk management. They are described in Unit 6.

It may be noted that Exchange may further "tighten" but cannot dilute the scope of SEBI Regulations. The following examples illustrate the "tightening" of regulations by Exchange/Clearing Corporation.

- *Number of contracts and their maturity*: Regulations allow a maximum of four contracts with the longest expiry date up to a year, but Exchange may list only one or two contracts for the nearest Expiry dates, depending on the liquidity.
- *Delivery Period for Settlement*: Regulations allow that delivery can be made on any business day during the Contract Month with prior notice of two business days, but Exchange may restrict the delivery to the last business day.
- *Margining*: Regulations may specify a minimum amount of, say, Rs 100, but the Clearing Corporation may specify *more than* Rs 100.

Exchange will also specify Base Price, Price Range and Quantity Freeze. Base price is the price that is used to compute the price range for the opening trade on any trading day. The base price is calculated by Exchange differently for the first day of contract's life (i.e. when it is introduced newly) and for subsequent days in its life, as follows.

> For the first day of contract's life: theoretical futures price computed according to the model specified by the Exchange.
>
> For subsequent days during contract's life: the daily settlement price of the previous trading day.

Price Range (also known as Price Freeze) is specified as plus or minus the specified percentage of Base Price, rounded to the nearest tick size, within which the opening price must trade. For example, if the base price for the trading day is 103.0000 and the

price range is 3% of the base price, then the opening price range (after rounding to the nearest 0.0025) will be:

Lower bound: 103.0000 / 1.03 = 100.0000

Upper bound: 103.0000 × 1.03 = 106.0900

In other words, the opening price must fall within the Price Range of 100.0000 and 106.0900.

For bond futures contracts (on 6-year, 10-year and 13-years), Stock Exchanges sets an initial price band of 3% of the previous closing price thus preventing acceptance of orders for execution that are placed beyond the set band. Whenever a trade in any contract is executed at the highest/lowest price of the band, Exchange may expand the price band for that contract by 0.5% in that direction after 30 minutes after taking into account market trend. However, not more than 2 such expansions in the price band are allowed in a day.

Quantity freeze is not a limit on the trade size (or limit on the outstanding trades, which is called Position Limit and explained below). Like Price Freeze, it is a check to ensure that the order entry is not erroneous. The Exchange will specify the Quantity Freeze, and any order input with quantity higher than the Quantity Freeze will not be executed automatically unless the Trading Member separately confirms to the Exchange that the order is genuine and without errors. The Quantity Freeze limit is periodically revised by the Exchange, depending on the liquidity in the contract. The current limits on Base Price, Price Range and Quantity Freeze for IRF contracts are as follows:

Parameter	**91-day T-Bill**	**10-year Bond**	**6-year Bond**	**13-year Bond**
Quantity freeze	7,001 lots or above	1,251 lots or above	1,251 lots or above	1,251 lots or above
Base Price	Theoretical price on the first day of the contract; daily settlement price of the previous day for other contract days	Theoretical price on the first day of the contract; daily settlement price of the previous day for other contract days	Theoretical price on the first day of the contract; daily settlement price of the previous day for other contract days	Theoretical price on the first day of the contract; daily settlement price of the previous day for other contract days
Price Operating Range	Plus or minus 1% of the base price	Plus or minus 3% of the base price	Plus or minus 3% of the base price	Plus or minus 3% of the base price

Fixed-income and Money Market Derivatives Association (FIMMDA)

FIMMDA is a self-regulatory organization for cash and derivatives markets in money and bond instruments. It publishes yield curve for bonds, which is used by Clearing Corporation to update the SPAN margining risk parameters. It also publishes the cash

market prices for various bonds, which are used in calculation of theoretical prices to determine Base Price and Daily Settlement Price.

7.2 Restrictions on Resident and Non-Resident Investors

Under the current regulations of the RBI, the following are the regulations on buying and selling of T Bill and T Bond futures.

Residents – non-supervised entities

Residents (as defined in Foreign Exchange Management Act 1999) are allowed to freely buy or sell interest rate futures for hedging and speculation.

Residents – supervised entities

RBI-supervised entities (i.e. banks, primary dealers and urban and state cooperative banks) should obtain prior permission from the RBI to deal in interest rate futures; and naked short-sale is allowed only for banks and primary dealers. Entities such as Mutual Funds, Insurance Companies, Housing Finance Companies, NBFCs who are supervised by other regulators (e.g. SEBI, Insurance Regulation and Development Authority, etc.) should similarly obtain prior permission of the concerned regulator.

Non-residents and Foreign Institutional Investors (FII)

The following exposure limits will apply to FII's registered with SEBI

- Purchase/Long Position: total position in cash and interest rate futures should not exceed the limit specified for investment in government securities
- Sold/Short Position: short position can be maintained only for hedging (and not for speculation) and the gross short position should not exceed the total long position in government securities in cash and interest rate futures

7.3 Limits on Open Interest

Position Limit is the limit on an investor's share in the total open interest. Under the current regulations of SEBI, the following are the position limits for both T Bill and T Bond futures. The limits are set as a percentage of gross open positions across all contracts.

	91-day bill futures	**10-year bond futures**	**6-year bond futures**	**13-year bond futures**
Client / Category III FPI / Scheme of Mutual Fund Level*	6% of total open interest or Rs 300 Cr, whichever is higher	3% of total open interest in the respective maturity bucket or Rs 200 Crore, whichever is higher	3% of total open interest in the respective maturity bucket or Rs 200 Crore, whichever is higher	3% of total open interest in the respective maturity bucket or Rs 200 Crore, whichever is higher
Trading Member / Category I & II FPI /	15% of total open interest or Rs 1,000 Crore,	10% of total open interest in the respective maturity bucket	10% of total open interest in the respective maturity bucket	10% of total open interest in the respective maturity bucket

Mutual Fund / Insurance Companies / HFC / Pension Funds Level*	whichever is higher	or Rs 600 Crore, whichever is higher	or Rs 600 Crore, whichever is higher	or Rs 600 Crore, whichever is higher
Clearing member level	No separate position limit is prescribed	No separate position limit is prescribed	No separate position limit is prescribed	No separate position limit is prescribed
Exchange level	25% of the outstanding underlying security	25% of the outstanding of underlying bond	25% of the outstanding of underlying bond	25% of the outstanding of underlying bond

** Additional restriction for FPIs: The total gross short (sold) position of each FPI in IRF shall not exceed its long position in the government securities and in Interest Rate Futures, at any point in time. The total gross long (bought) position in cash and IRF markets taken together for all FPIs shall not exceed the aggregate permissible limit for investment in government securities for FPIs.*

7.4 Regulatory Reporting

For the RBI-supervised entities, the following reporting applies.

By	To	Periodicity	Report
CSGL Holder	RBI	Weekly	Transactions between its constituents; and between itself and its constituents
CSGL Holder	RBI	Quarterly	Constituent-wise holdings
NBFCs	RBI	Half-yearly	Total turnover in interest rate futures separately for purchases and sales
Primary Co-operative Banks	RBI	Monthly	Activity during the month; outstanding positions at month-end; hedges that are highly effective and otherwise

For banks and all-India financial institutions, the following reports are to be submitted to the RBI at monthly intervals.

1. Outstanding futures positions and share in open interest
2. Activity during the month (opening notional, notional traded, notional reversed, and notional outstanding)
3. Analysis of “effective” hedges
4. Analysis of “NOT effective” hedges

In addition, the following disclosures must be made as part of the notes on accounts to the balance sheet.

1. Notional amount of futures traded during the year (instrument-wise)
2. Notional amount of futures outstanding on balance sheet date (instrument-wise)
3. Notional amount of futures outstanding and not effective for hedge (instrument-wise)

4. MTM vale of futures outstanding and not effective for hedge (instrument-wise)

7.5 Role of FIMMDA in Fixed Income and Derivatives Markets in India

The Fixed Income Money Market and Derivatives Association of India (FIMMDA) is an association of Scheduled Commercial Banks, Financial Institutions, Primary Dealers and Insurance Companies. FIMMDA is a voluntary market body for the bond, money and derivatives markets. FIMMDA has members representing all major institutional segments of the market. The membership includes Nationalized Banks, Private sector banks, Foreign Banks, Financial institutions, Insurance Companies and all Primary Dealers.

As an industry association, FIMMDA addresses issues that affect the entire industryand is engaged in the development of Fixed Income and Derivatives market in India. FIMMDA performs the following roles:

- Functions as the principal interface with Regulators
- Mandated by the Reserve Bank of India for valuation of Government Bonds, Corporate Bonds and Securitized Papers for valuation of investment portfolios of Banks and Primary Dealers
- Undertakes developmental activities such as introduction of benchmarks and new products
- Suggests Legal and Regulatory framework for the development of new products
- Training and Development Support to the Debt & Derivatives Market
- Standardisation of market practices

One of the main objectives of FIMMDA is to recommend and implement healthy business practices, ethical code of conduct, standard principles and practices to be followed by the members in their dealing of securities. For this, FIMMDA has prepared a handbook ("FIMMDA Handbook of Market Practices") which can be accessed on FIMMDA's website (www.fimmda.org).

FIMMDA has also prepared a code of conduct ("FIMMDA Code of Conduct for Derivatives Transactions") in respect of derivative transactions particularly those involving end users to ensure a minimum common standard of market practices. This code of conduct lays out guidelines to be followed by all FIMMDA members and other market participants while undertaking derivatives transactions. These guidelines would broadly address issues relating to (a) Suitability and Appropriateness standards and procedures, (b) standards for reasonability of rates, (c) guidelines to avoid transactions that could result in acceleration/deferment of gains or losses and (d) guidelines for introduction of new products in the market.

7.6 Accounting

The Institute of Chartered Accountants of India (ICAI) is a statutory body to define the accounting, presentation and disclosures by corporations. Its accounting Standard, AS 30, specifies the accounting for all derivative transactions. The summary of derivatives accounting treatment is as follows:

- All derivative transactions must be brought into the balance sheet though they are to be settled after the balance sheet date
- The value of derivative in the balance sheet is its "fair value", which is its current mark-to-market (or liquidation) value, and not its notional amount. For example, if the notional is Rs 10 Cr and the mark-to-market value is Rs 2 lakhs, then the derivative would be accounted for in the balance sheet at Rs 2 lakhs.
- The fair value will be taken to the Profit/Loss Account except for transactions qualifying as Hedging Transactions
- Hedging Transactions are those that eliminate the interest rate risk in the asset or liability or highly forecast transaction. To be qualified as a hedging transaction, it must pass the hedge effectiveness test, which is test to prove that the derivative will effectively offset the profit/loss in the underlying hedged item within the limit of 80 – 125%. The hedge effectiveness test must be passed at the beginning of hedge ("prospective test") and during the life of the derivative contract, based on the past changes in the price/value of hedging item and hedging derivative ("retrospective test"). The profit/loss on the underlying hedged item and hedging derivative must be taken together into the Profit/Loss Account. If the underlying hedged item is a highly forecast transaction, its profit/loss will not be accounted in balance sheet. In such cases, the profit/loss on the hedging derivative need not be taken to Profit/Loss Account but stored in a separate account under Equity, which will be taken into Profit/Loss Account when the forecast transaction materializes. This facility is provided to avoid volatility in earnings caused by realized profit/loss in hedging derivative and unrealized profit/loss on the forecast transaction. This is called "hedge accounting". If the hedge effectiveness test is failed, the hedge account has to be discontinued, and the profit/loss on the hedging derivative will have to be taken into Profit/Loss Account.

For the RBI-supervised entities, RBI has restricted the scope hedge accounting as below:

- Hedged item can be only government security that is categorized in either Available-for-Sale (AFS) or Held-for-Trading (HFT). It cannot be any other security or in other category.
- If the hedge effectiveness test is passed, the changes in the value of hedged item and hedging instrument can be offset. If the net amount is loss, it should be taken into Profit/Loss Account; and if it is profit, it should be ignored.
- If the hedge effectiveness test is not passed, the setoff between hedged item and hedging instrument is not allowed. The hedged item must be marked to the market, as per the norms applicable to the category (i.e. AFS or HFT), and the hedging derivative should be marked to the market on a daily basis with losses provided for and gains ignored for the purpose of Profit/Loss Account.

Gains from close-out or settlement of derivative cannot be taken into Profit/Loss Account but carried forward under "Other Liability" and is to be used for meeting depreciation provisions on the investment portfolio.

Sample Questions

1. The regulator for the primary market of government securities is _____.
    a. **Reserve Bank of India**
    b. Securities and Exchange Board of India
    c. Government of India
    d. Stock Exchanges

Ans: (a)

2. The regulator for the secondary market of government securities is _____.
    a. **Reserve Bank of India**
    b. Securities and Exchange Board of India
    c. Government of India
    d. Stock Exchanges

Ans: (a)

3. The regulator for the Exchange-traded interest rate derivatives is _____.
    a. Reserve Bank of India
    b. **Securities and Exchange Board of India**
    c. Clearing Corporation
    d. Stock Exchanges

Ans: (b)

4. Which of the following category of market participants can use interest rate derivatives?
    a. Mutual funds
    b. Foreign institutional investors
    c. Retail investors
    d. **All of the above**

Ans: (d)

5. Which of the following category of market participants can short-sell bond futures?
    a. Mutual funds
    b. **Foreign institutional investors**
    c. Retail investors
    d. All of the above

Ans: (b)

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Chapter 8: Trading and Hedging

LEARNING OBJECTIVES:

After studying this chapter, you should know about:

- Trading strategies with T-Bills and T-Bond futures
- Hedging strategies and adjustment to portfolio modified duration
- Basis risk, yield curve spread risk and market liquidity risk

8.1 Trading Strategies

Trading is taking market risk (or speculation). Market risk in bond consists of credit risk and interest rate risk with the latter arising in two forms: price risk and reinvestment risk (see Sec 3.4 and 4.1). T Bill and T Bond are issued by a sovereign government and therefore there is no credit risk. In the cash market, T Bill has no reinvestment risk because it is a zero-coupon instrument but T Bond has reinvestment risk. However, in the futures market, both T Bill and T Bond futures have no reinvestment risk because the time to expiry is a maximum of one year during which the effect of reinvestment risk (for T Bond futures) is negligible.

To sum up, what we trade with T Bill and T Bond futures is the price risk component of interest rate risk. The relationship between changes in interest rate and the price of rate-sensitive instruments is inversely proportional. That is, of the rate goes up, the price of rate-sensitive instrument goes down, and vice versa.

For trading, we must decide three parameters: (1) instrument; (2) market size; and (3) Contract Month.

Instrument (i.e. T Bill or T Bond futures) will depend on the tenor of interest rate we want to trade. T Bill price is determined by short-term rate of three months (because the underlying has a maturity of 91 days) and T Bond price is determined by long term rate of 10 years (because the underlying is a 10Y bond).

Market side (i.e. buy or sell futures contract) will depend on our expectation about the direction of rate change in future. If we expect the rate to go up in future, then the instrument price will fall in future, implying that we should sell futures contract now and subsequently buy it later when its price falls. Similarly, if we expect the rate to go down in future, then the instrument price will rise in future, implying that we should buy futures contract now and subsequently sell it later when its price rises.

Contract Month will depend on the timing of expected rate change. If we expect the rate change to occur in one month, we should chose a contract that expires in one month; if we expect the rate change to occur in three months, we should choose a contract that expires in three months; and so on. The following summarizes the selection of these parameters.

Parameter	Selection
Instrument	Linked to tenor of rate being traded For 3M rate, use T Bill futures; For 10Y rate, use 10Y T Bond futures
Market side	Linked to expected change in the direction of rate For up move in rate, sell futures; for down move in rate, buy futures
Contract Month	Linked to when we expect the change in rate to occur The timing of expected change in rate should be the same as Contract Month of futures

Example 1

We are in January and the current 3-month interest rate is 5% so that current price of 3-month T Bill will be 98.75. If we expect the 3-month rate to go up to5.15% by end of March, the expected price of 3-month T Bill at the discount rate of 5.15% will be 98.7125.

Accordingly, we should sell March T Bill futures now and square it during March when the price is expected to fall to about 98.7125, realizing a profit of 0.0375 per 100 face value. Given that one contract is for 200,000 notional, the profit on one contract will be:

$$200{,}000 \times (0.0375/100) = 75.$$

Example 2

We are in March and the current 10Y interest rate is 6.75% so that current price of 7% 10Y T Bond will be 101.7975. If we expect the 10Y rate to go down to6.50% by end of December, the expected price of 7% 10Y T Bond at the yield-to-maturity of 6.50% will be 103.6350.

Accordingly, we should buy December T Bond futures now and square it during December when the price is expected to fall to about 103.6350, realizing a profit of 1.8375 per 100 face value. Given that one contract is for 200,000 notional, the profit on one contract will be:

$$200{,}000 \times (1.8375/100) = 3{,}675.$$

NOTE: the prices in the above example are for cash market prices. The futures prices will be slightly different from the above on trade date but the prices on settlement date will be the same as above since the futures price and cash price will converge on the settlement date.

8.2 Hedging Strategies

Hedging is the opposite of trading: eliminating the existing price risk. It is important to note that risk is defined as the uncertainty about the future cash flows. If the futures cash flows are fixed and known (in terms of their size and timing) at the outset, there is no risk. If you have taken a fixed-rate loan, there is no risk because you know in advance how much you will have to pay in future. On the other hand, if you have taken a

floating-rate loan, there is risk because you do know in advance how much you will have to pay in future for the interest. Thus, converting a floating-rate loan into a fixed-rate loan is hedging; and converting fixed-rate loan into floating-rate loan (in the expectation that the rate in future will be lower) is speculation/trading.
To understand the application of hedging with bond futures, we must recall the concept of Modified Duration and other risk measures explained in Section 3.4. Let us recall the following definitions.

Modified Duration (MD)*:* it is a dimensionless number that tells us the percentage change in bond's price caused by a given change in the yield. For example, if MD is 5.5 for a bond, then it implies that if the yield changes by *Z%*, the percentage change in bond price is5.5 *×Z%*.

Rupee Duration (RD): it is the absolute change in the total market value of bond for a given change in the yield. For example, if MD is 5.5 for a bond, change in the yield is *Z%*, market price is *P* and the face value quantity is *Q*, then RD is:

$$Q\times (P / 100) \times 5.5 \times Z\%$$

Price Value of a Basis Point (PVBP): it is the same as RD except that the change in yield is considered at one basis point (or 0.01%).

$$Q\times (P / 100) \times 5.5 \times 0.01\%$$

To hedge a bond or bond portfolio in futures market, we must match the PVBP of both bond position and the futures position in an offsetting manner: gain on one will be offset by the loss on the other. Bond futures derives its Modified Duration or PVBP from the underlying Cheapest-to-delivery (CTD) bond (see Sec 5.7) it tracks and the link between the PVBP of bond futures and that of CTD bond is the Conversion Factor (CF). The relation between equivalent prices in cash and futures market is

Adjusted futures price (or equivalent cash price) = Futures Price $\times$ CF

or

Adjusted cash price (or equivalent futures) price = Cash Price / CF

Accordingly, the PVBP (or MD) of futures contract is

Futures PVBP or MD (per contract) =

Cash PVBP or MD of CTD bond per futures contract / CF

Buying futures will add to the portfolio MD and selling it will reduce it. The number of futures contracts to be bought or sold for adjustment of portfolio MD will be computed as follows. Let

$PVBP_C$ = Current price value of basis point (PVBP) of the cash portfolio

$PVBP_F$ = price value of basis point (PVBP) per futures contract

MD_C = Current portfolio MD

MD_T = Target portfolio MD

To match the sensitivity of the portfolio, the number of futures contract on the opposite market side must therefore be

$$PVBP_C / PVBP_F$$

Since the portfolio sensitivity is to be changed from MD_C to MD_T, their ratio would be the scaling factor and the number of futures contract required would be

$$(PVBP_C / PVBP_F) \times (MD_T / MD_C - 1)$$

Example on hedging

We have a bond portfolio whose current market value is Rs 5.74 Cr and its Modified Duration is 6.28. How will you hedge this portfolio against interest rate risk?

Step #1: Determine the PVBP of cash position ($PVBP_C$)

$$PVBP_C = 5,74,00,000 \times 6.28 \times 0.01\% = 36,047.20$$

Thus, if the yield changes by one basis point, the market value will change by Rs 36,047.20.

Step #2: Determine the PVBP of one futures contract ($PVBP_F$)

The futures price is currently 95.2375 and the CTD bond that is currently tracked by futures contract has a MD of 7.62 and current market price of 104.6523. The Conversion Factor for this CTD bond is 1.0949. Since the contract amount is Rs 200,000 for futures, the futures PVBP per contract is

$$PVBP_F = 200,000 \times (104.6523/100) \times 7.62 \times 0.01\% / 1.0949 = 145.67$$

Step #3: Determine the number of futures contracts required for hedge

Number of futures contracts = 36,047.20 / 145.67 = 247.46

Rounding of the nearest integer, the number of futures contracts will be 247. Since we are long on cash bonds, to hedge the interest rate risk, we must sell 247 futures contract so that profit (or loss) on cash will be offset by the loss (or profit) in the futures positions.

Adjustment of Modified Duration for a bond portfolio

In some cases, we do not want to hedge but keep the Modified Duration of bond investment portfolio at a desired target level. We will use the same example as in the previous section. The aim now is to reduce the risk of bond portfolio from MD of 6.28 to MD of 3.5. How many futures contracts should we sell to reduce the MD to the desired target of 3.5?

We have already computed the $PVBP_C$ and $PVBP_F$ to be 36,047.20 and 145.67, respectively. Given that the current MD is 6.28 and the desired MD is 3.5, the scaling factor for this adjustment is 3.5/6.28. Therefore, the number of futures contracts required for this adjustment is

$$(36,047.20 / 145.67) \times (3.5 / 6.28 - 1) = -109.54 \approx 110.$$

If the sign is positive, we need to buy the required number of futures contracts; and if it is negative, we need to sell them. Thus, if we sell 110 futures contracts at the current price of 95.2375 (see the previous section), then the PVBP of the portfolio will be such that it corresponds to the target MD of 3.5. Note that this would work only when there is a parallel shift in the yield curve.

In adjusting the portfolio MD, if we expect parallel shift (i.e. change in the rate level without change in the slope) in the term structure, we may use a single futures contract on the underlying of any maturity. For example, we can use futures on 2Y-maturity underlying, 10Y-maturity underlying, etc. However, if we expect steepening or flattening (i.e. change in the slope or shape) in term structure, we should use multiple futures on underlying bonds with different maturity, corresponding to the key points in the curve. For example, if the key maturity points are 2Y, 5Y and 10Y, then we must use three different futures contracts whose underlying has maturity of 2Y, 5Y and 10Y. For each of the 'maturity bucket', the number of futures contracts to be bought or sold is given by the formula above. The strategy of multiple-maturity futures overlay corresponds to the gap analysis for duration-balancing in the cash market.

8.3 Basis Risk, Yield Curve Spread Risk and Market Liquidity Risk

Hedging with futures cannot eliminate the price risk *completely*, but reduces it and transforms it into less serious basis risk.

Basis risk

Basis risk arises from standardization of futures contract for amount and expiry date. Since futures contract can be bought or sold only in multiples of 200,000 notional, any amount that needs to be hedged but is not a multiple of contract amount leaves a mismatch between exposure amount and hedged amount. For example, you need to hedge an exposure of 900,000, which requires the futures contracts of

$$900{,}000 / 200{,}000 = 4.5$$

Since we can buy or sell only in integral multiples, we need to buy or sell either four or five contracts. The former leads to under-hedging and the latter, to over-hedging.

Second, the futures contract expires on the last business day of contract month. If the exposure to be hedged has maturity of some other day in the month, there will be mismatch in the maturity. For example, the exposure has a maturity of November 15, and the futures contracts are available for March, June, September and December, all of which expire on the last business day of their months. The nearest futures contract suitable to the hedge is December contract. On the due date of exposure, which is November 15, we square up the December futures contract.

The discrepancy in the amount and maturity of exposure and the futures contract leaves a residual risk called basis risk. There is a third source of basis risk, which is the differential price change in the exposure and futures contract. If the exposure changes in value by, say, 1%, the futures contract may change by 0.9% (or 1.1%). The difference in the price changes leads to third source of basis risk.

Yield curve spread risk

Yield curve spread risk arises when the term structure shifts are not parallel (see Sec 2.5) but steepening or flattening. For example, the 10Y rate may change by 0.25% but the 15Y rate may change only by 0.15%. This poses problem when the tenor of exposure to be hedged is different from the tenor of futures contract.

For example, you have a 20Y floating rate housing loan with yearly interest rate resets. To hedge the interest rate risk and avoid the uncertainty about future interest payments, you will sell the futures contract. If the interest rate goes up, your interest payment on the loan goes up but you gain on the futures contract because its price would have fallen when the rate has gone up. There is a problem in tenor of rate in the loan and the futures hedge. Though the loan is for 20 years, the reset is yearly, implying that the rate you are paying in the loan has a tenor of 1Y. The futures contract you sold has a tenor of 3M (if it is T Bill futures) or 10Y (if it is 10Y T Bond). The change in 1Y rate and 3M (or 10Y) rate may not be same, which is the yield curve risk.

In practice, the futures hedge is simultaneously exposed to both basis risk and yield curve spread risk. Yield curve risk is the differential movements in the rates of different tenor; and basis risk is the differential movement in the loan rate and futures contract price. The loan rate is typically linked to the lending bank's prime rate, which may not move in tandem with the market rate implies in the futures contract.

Market liquidity risk

Market liquidity risk is the inability to quickly buy or sell futures contract without disturbing the futures price. If there is no market liquidity, the futures price is de-linked from the price of cash markets, and determined by demand-supply in futures market and liable for squeeze. It can be dangerous to trade in market that has no market liquidity.

Sample questions

1. Which of the following risks can be hedged with T Bill and T Bond futures?
    a. Credit risk
    b. Price risk
    c. Reinvestment risk
    d. All of the above

Ans: (b)

2. For hedging or speculation, which of the following features of futures contract will be relevant?
    a. Underlying for the futures
    b. Contract Month
    c. Market side
    d. All of the above

Ans: (d)

3. If you expect the interest rate will go up in future, today you should _____.
    a. Sell futures
    b. Buy futures
    c. Either (a) or (b)
    d. None of the above

Ans: (a)

4. Basis risk arises from _____.
    a. Mismatch between the amount of exposure and futures notional
    b. Mismatch between the maturity/expiry of exposure and futures contract
    c. Differential price changes in the exposure and futures contract
    d. All of the above

Ans: (d)

5. Futures contracts can be used to modify the exposure portfolio's Modified Duration in the following way/s: _____.
    a. To increase portfolio's Modified Duration
    b. To decrease portfolio's Modified Duration
    c. Either (a) or (b)
    d. None of the above

Ans: (c)

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